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THE HISTORY OF ANAESTHESIA SOCIETY PROCEEDINGS

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Honorary Editor
Rajinder K Mirakhur

THE HISTORY OF ANAESTHESIA SOCIETY PROCEEDINGS

VOLUME 55

Contents of Volume 55

Acknowledgements

I would like to acknowledge the help of all the authors whose presentations at the meeting and whose manuscripts have made this publication possible.

I would like to acknowledge the help of Dr Adrian Kuipers, Dr Ken MacLeod, Dr Declan Warde and all other members of the Council. My thanks to Dr Alistair McKenzie for the photographs of some of the speakers.

My thanks to Dr John Pring for meticulously reviewing the manuscripts, and arranging the printing and distribution of the Proceedings.

Scientific Programme of the Llandudno Meeting 2023

Wednesday, 11 October 2023

Session 1:
Chair: Dr John Pring

James Moore: A man before his time.
Professor Tony Wildsmith

The physiologists who 'oxygenized' sport.
Dr Peter Featherstone

Anaesthesia for radiotherapy in young children. Two members' experiences.
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(*Joint presenters)

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How have animal studies and veterinary anaesthesia shaped the way we practise today?
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William Ernest Henley (WEH) and his '*In Hospital*' poems
Professor Peter Hutton

Sir Anthony Jephcott's Macintosh laryngoscope cufflinks
Professor Barry Baker

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(*Presenter)

Thursday, 12 October 2023

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Japanese paediatric anesthesia in 1830s
Dr Kentaro Dote, Dr Masayuki Yano, Dr Kazushi Takaishi, Dr Taro Fujitani, Dr Hiroshi Makino*
(*Presenter)

John MacDonnell and the first anaesthetic in Ireland
*Dr Joseph Tracey**
(*Dr Tracey was unable to attend; paper presented by Dr Declan Warde)

Could chloroform have been as safe as halothane?
Dr Henry Connor, Dr Alistair McKenzie*
(*presented the paper)

Sir Ivan Magill 1888 – 1986.
Dr Adrian Padfield, Ms Caroline Hamson**
*(*Joint presenters)*

Session 6:
Chair: President, Dr Adrian Kuipers.

Guest lecture:
A Brief History of 'Llandudno'
Mr Rhodri Clark

HISTORY OF ANAESTHESIA SOCIETY

Scientific Meeting, Imperial Hotel, Llandudno

11-12 October 2023

Scientific Programme Organiser: Dr Declan Warde
Meeting Organiser: Dr Adrian Kuipers

FUTURE MEETINGS

UK History of Anaesthesia Society

The next meeting of the Society will take place on 25-26 September, 2024 at Market Harborough, Northamptonshire.

Further Information will be available in due course at www.histansoc.org.uk

The History of Anaesthesia Society Proceedings
Honorary Editor

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Belfast, Northern Ireland
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HISTORY OF ANAESTHESIA SOCIETY

Council and Officers – October 2023

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Dr Adrian Padfield, Cheltenham
Dr John Pring, Penzance
Professor JAW (Tony) Wildsmith, Cirencester
Dr David Wilkinson, Llanddulas, Conwy
Mrs Patricia Willis, London

David Zuck Memorial Prize 2023

Adjudication committee

Professor Rajinder Mirakhur (Chair)
Dr John Pring
Dr Marten van Wijhe

There were five excellent entries for this prize.

The winner of the David Zuck Memorial Prize 2023 was the following publication:

Peter J. Featherstone. John Henry Evans, MD: Founding Chairman of the Board of Governors of the International Anesthesia Research Society, and a Forgotten Pioneer of Oxygen Therapy. Anesthesia and Analgesia 2022, 135: S18-S25

Peter J Featherstone

John V. Farman Intensive Care Unit, Addenbrooke's Hospital, Cambridge University Hospitals National Health Service (NHS) Foundation Trust, Hills Rd, Cambridge CB2 0QQ,

The Committee and the Council extend their congratulations to Dr Featherstone.

Deaths of Members 2022-23

Dr Anne Florence	Liverpool
Dr David McCallum	Edinburgh

Llandudno Meeting: Speakers' photographs


Professor Tony Wildsmith


Dr Peter Featherstone


Dr Ann Ferguson


Dr Ian McLellan


Dr Rachel Wood


Dr Rakhi Ghosh


Dr Laura Powell


Dr Hanin Ramadin


Professor Gauhar Afshan

Dr Marten van Wijhe

Professor Aliya Ahmed

Professor Peter Hutton

Professor Barry Baker

Dr Declan Warde

Dr David Wilkinson

Professor Kentaro Dote

Dr Henry Connor

Dr Adrian Padfield

Ms Caroline Hamson

Mr Rhodri Clark

LIST OF DELEGATES

History of Anaesthesia Society Meeting
Llandudno, 11-12 October 2023

Dr Neil Adams
Professor Gauhar Afshan
Professor Aliya Ahmed
Dr Jessica Annett
Professor Douglas Bacon
Prof Barry Baker
Dr Jane Baker
Dr Moyna Barton
Dr Liz Bradshaw
Dr John Cahill
Dr Henry Connor
Professor Kentaro Dote
Professor Alan Dronsfield
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Dr Ann Ferguson
Dr Rahki Ghosh
Ms Saoirse Gibson
Dr Michael Gough
Dr Paul Goulden
Miss Caroline Hamson
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Mrs Janet Pickles
Mr Christopher Pickles
Dr Jagtar Pooni
Dr Laura Powell
Dr John Pring
Dr Hanin Ramadan
Dr Anna-Maria Rollin
Dr Miles Rucklidge
Dr Andrew Severn
Dr Christopher Seymour
Mr Ian Smith
Dr Philip Taylor
Dr Marten Van Wijhe
Dr Declan Warde
Professor Tony Wildsmith
Dr David Wilkinson
Dr Rachel Wood

EDITORIAL

The Annual Meeting of the History of Anaesthesia Society was held in the picturesque seaside town of Llandudno in Wales. Apart from the discussion of scientific topics, we were enlightened with the history of Llandudno by our Guest Speaker Mr Rhodri Clark a freelance journalist from Conwy. He explained how he and his colleagues have placed QR codes over many historic sites and smartphone or other such accessory users can simply swipe their devices over the codes to learn about the history of the site.

Presentations on a variety of subjects were made and discussed during the two day meeting. A highlight of this year's meeting was the participation of four trainees in the scientific sessions and the attendance of two senior members of the specialty from Pakistan.

The two speakers from Pakistan showed the struggles a developing country has to go through to establish the specialty and then make it grow. It includes establishing the standards for the practice of anaesthesia and in parallel establish the academic side and training standards. Finance and manpower are the main problems to establish the specialty. However, good progress has been made.

Our Society still needs to explore ways in which to increase the membership of the Society, particularly attracting the younger generation. Attracting young members is important for the both the continuation and growth of the Society. It was heartening to see more presentations at the meeting in Llandudno from Anaesthetists in Training.

As this is the last issue of the Proceedings which I am editing, I would like to thank the History of Anaesthesia Society for giving me the privilege of editorship. I would like to extend my best wishes to my successor.

Rajinder Mirakhur
Hon Editor

James Moore (1762-1834*): A man before his time

Prof J A W Wildsmith
Ampney Crucis, Cirencester, UK

An important rule in quoting any published source of information is to make sure that you actually see the document yourself to confirm that the quoted author actually stated what you think, and also that the reference details are correct. An error in either, the result of taking at face value what a third party has published elsewhere, can be very embarrassing proof that you have **not** seen the document yourself. Some 40 years ago, producing a review of the history of regional anaesthesia [1], I wished to quote the following account of nerve compression:

> Moore J. *A Method of Preventing or Diminishing Pain in Several Operations of Surgery*. London: Cadell, 1784.

However, I was unable to trace a copy of the original, and the risk of making an embarrassing error by reproducing what others have quoted incorrectly is illustrated by some spelling the publisher's name as "Cadel", and not as above. I was advised to have a picture of Moore's nerve compressor redrawn from one of the several secondary sources, but not to quote any reference, the argument being that no reference is better than an incorrect one [2]. Checking the position for subsequent editions did nothing to change the situation until earlier this year when a 'Google' search identified two key results:

1. A digitised copy of an original is available at the University of Bristol Library via The Wellcome Collection's website [3]; and

2. A facsimile edition, published in 2018, is commercially available [4].

The Bristol University copy is fully accessible and usable without restriction so that it provides ready access to Moore's original illustrations and, more importantly, also makes his text available for study. What is in that little book shows exactly why pursuit of an original is so important, and makes me wish that the internet had been available 40 years go!

It is a slim volume of 50 pages, in a size a little smaller than modern A5, and is addressed to three surgeons, John Gunning, John Hunter and Charles Hawkins, at St George's Hospital where Moore had recently served as House Surgeon. The text is without sections, but its sequence is remarkably similar to the 'IMRAD' structure used for modern scientific papers, as outlined below:

Opening discussion (Introduction)

The problem is defined	The pain of surgery
A solution is proposed	Recognise and treat it
Options considered	Anodynes, but even Opium dismissed as inadequate
	Nerve section 'effective', but dangerous and painful in itself
	Nerve compression, as in prolonged sitting, his option

Description of self-experimentation (Methods)

1. Simple thigh tourniquet ineffective and poorly tolerated.
2. Sciatic nerve clamp, avoiding 'crural' artery pressure, well tolerated and effective after 30min, but femoral nerve distribution unaffected (unsurprisingly).
3. Pressure on both nerves practicable without ischaemia with careful positioning, and resulted in complete numbness below knee joint.

He presented his proposal to John Hunter who offered trial in a patient about to undergo below knee amputation.

Clinical trial (Results)

The day before surgery (sadly no exact date given) a test on patient had good effect in 30 minutes.

On the day of operation the compression procedure was repeated and:

> '*A few minutes after twelve, the tourniquet was applied, and the amputation performed by Mr Hunter, at the usual place below the knee. At the circular incision through the skin, the patient did not cry out, change a muscle of his face, or shew any symptom of pain'*

Description of reactions (Discussion)
Moore's comment was simple: '*The trial had all the success I expected'.*

However, others were less enthused, and the feeling from his writings is one of indifference. Some dismissed the patient's lack of reaction as the effect of the morphine, or objected to the possibility of any vascular occlusion (in spite of Moore's avoidance of pressure on the femoral artery), or even dismissed the method as 'only' of use for operations below the knee joint! No evidence of trial by others has been identified, but perhaps the need for very precise placement of Moore's device and at least 30 minutes of application might challenge the patience of those less committed to the idea.

Moore's account of his thoughts, experiments and the trial with Hunter is thorough, but perhaps the most impressive part of the book is the opening section where he argues, quite extensively, for the necessity of finding a way of obtunding the pain of surgery. However, the reactions to his demonstration make it plain that surgery was not yet ready for being painless although he could not have put it more succinctly than . . .

> *'But when people consider the degree of pain given by some surgical operations, they must acknowledge, that to diminish or prevent a few minutes of such pain, is an object highly desirable, both to the patient and surgeon.'*
> . . . and all this in 1784?

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1. Wildsmith JAW. The history and development of regional anaesthesia. *In* Wildsmith JAW, Armitage EN (Eds) *Principles and Practice of Regional Anaesthesia*. Churchill Livingstone, Edinburgh, 1987: pp1-7.
2. Masson AHB. Personal Communication.
3. https://wellcomecollection.org/works/awkh78cp; accessed 10.10.2023
4. https://www.gale.com/intl/primary-sources/eighteenth-century-collections-online; Accessed 14.10.2023

The physiologists who 'oxygenized' sport (abstract)

Peter J Featherstone
Consultant in Intensive Care Medicine and Anaesthesia,
Cambridge University Hospitals NHS Foundation Trust

During the summer of 1908, Leonard Hill and Martin Flack, from the Department of Physiology, London Hospital Medical College, embarked on a series of experiments to assess the influence of supplementary oxygen on athletic performance. One week after competing for Great Britain in the 1908 Olympics, Harold Holding and Theodore Just ran several middle distance time trials, each preceded by the inhalation of oxygen for two minutes. Holding covered the quarter mile in 50.2 seconds, and to the astonishment of officials, 'was no more blown than after a 100 yards race.' Just meanwhile attained a personal best time for the half-mile run. Hill and Flack concluded that athletes 'have every hope of materially shortening the record times and accomplishing greater feats by the use of oxygen'. They postulated that 'the occasional breathing of oxygen should prove of benefit in long-continued efforts such as the Marathon and the Channel swim.' [1]

Soon after, oxygen was trialled by several swimmers, including Elaine Golding, who was widely regarded as the best female amateur swimmer of her generation, [2] and Jabez "Jappy" Wolffe, who utilised oxygen during his 11th (unsuccessful) attempt to swim the English Channel. [3] These early attempts to 'oxygenize athletics' [4] quickly engendered debate on both sides of the Atlantic, with some questioning whether the use of oxygen constituted doping, and others denouncing its employment as 'un-English and most unsportsmanlike'. [5]

Nevertheless, the employment of oxygen was subsequently extended to many other sports, and in the decades that followed, physiologists and sports scientists continued to investigate the ergogenic effects of oxygen. This controversial research remains ongoing today.

References

1. Hill L, Flack M, Just TH. The influence of oxygen inhalations on athletes. *British Medical Journal* 1908; 2: 499-500.

2. At last, the oxygen bracer. *New York Daily Tribune,* September 13, 1908.
3. Hill L. Oxygen and muscular exercise as a form of treatment. *British Medical Journal* 1908; 2: 967-968.
4. Oxygenized athletics. *New York Times* September 1, 1908.
5. Oxygen. *The Sporting Times* October 3, 1908.

Anaesthesia for radiotherapy in young children: Two members' experiences

Dr Ann Ferguson[1], Dr Ian McLellan[2]
[1]Retired Consultant Anaesthetist, East Kent Hospitals
[2]Retired Consultant Anaesthetist, Groby Road Hospital, Leicester

This manuscript is based on the experience of two anaesthetists trained at the St Bartholomew's Hospital (Bart's), London in the late 1960s (AF) and early 1970s (IMcL).

During our time in anaesthesia, a large number of changes, mostly for the better, have taken place. These include the change in practice in administering anaesthesia repeatedly to infants and small children in the radiotherapy department in the time we worked in the Barts. These experiences form the basis of this manuscript.

Part I: Trilene and terror

Anaesthesia as taught to juniors at the time of which we are speaking, was using nitrous oxide and oxygen from cylinders on a standard Boyle's machine, with an additional volatile anaesthetic agents. Sodium thiopentone was used as the induction agent in adults.

The available inhalational agents were:

Chloroform
Although available, was rarely used.

Ether
It provided a very slow induction, was irritant, and there was a great danger of sparks causing a fire.

Halothane
The introduction of halothane in 1956 was a great advance; it was faster in onset and recovery, less irritant, not inflammable and could be used with soda lime in a semi-closed circuit, or with a Waters cannister. There were however two major contraindications to its use; it was not recommended for

repeated anaesthesia at less than six weeks intervals because of the danger of hepatitis, and it could not be used in obstetrics, because it relaxed the pregnant uterus.

Trichlorethylene
This was the only alternative agent available. Its use might well have been discontinued had halothane not the above disadvantages.

Trichlorethylene was synthesised in 1864 and was in widespread use as a degreasing agent, especially in Germany in the first world war and also as a dry cleaning agent [1].

There were reports of nerve damage to workers in this industry, these were later thought to be due to impurities rather than the agent itself.
Striker and colleagues in the USA noted the analgesic properties of trichlorethylene and attempted to use it as a general anaesthetic agent, employing various vapourisers, but found it was irritant, probably due to impurities. They changed to using a purified form of trichlorethylene which they called Trethylene [1]. It was used for general anaesthesia for superficial procedures such as dental extractions. The patients were then sent home on the streetcar, so it is doubtful whether this was anaesthesia as we would now describe it. In no case did they use it for major surgical procedures such as laparotomies.

The Council of Pharmacy and Chemistry of the American Medical Association concluded in 1936 that the case for trethylene as an anaesthetic agent had not been completely made, and attempts to use it in the USA as an anaesthetic ceased.

By 1940, in Great Britain, the "Anaesthetics committee", which had originally been set up by the MRC and Anaesthetics section of the RSM for other reasons, was approached via the honorary secretary, Dr Hadfield, by a Mr C Chalmers (chemist from London) asking about trichlorethylene. He had obtained some trichlorethylene, tried it on himself, and thought it would be a useful anaesthetic agent [2].

Langton Hewer investigated trichlorethylene as an anaesthetic and published an interim report in the BMJ quoting animal experiments [2]. He discovered

that Trilene was already being manufactured by ICI in a form suitable for analgesia in labour from a special inhaler, and in snap ampoules for trigeminal neuralgia and burns dressings.

Hewer considered all the data and concluded that it was justifiable to pursue the investigation of trichloroethylene as an anaesthetic in the human subject. He administered 127 anaesthetics using nitrous oxide and oxygen in a continuous flow system from a Boyle's machine, using Trilene in the chloroform bottle [2]. Thymol 0.01% was used as the preservative. Hewer was a cautious man often known as "Gloomy" [3] and only said that further investigation of trichlorethylene was justified.

Langton Hewer provided a much more detailed report of 400 administrations of trichlorethylene in 1942, mentioning that he had found it to have advantages over chloroform. He found it less potent as an anaesthetic, more potent as an analgesic but less toxic than chloroform [4]. He was not more positive than this.

Hewer suggested to ICI that they add a colouring agent to Trilene so it could be easily distinguished from chloroform. This was done with 1:200,000 waxoline blue. The Trilene bottle was filled up via the cork on the top. The waxoline blue became more and more concentrated as Trilene got used, the blue becoming darker and darker, which later led to its name of "Barts Ink". Junior staff at Barts, were taught that this colouring was to stop them from taking it to clean clothing [4]. Enderby noted in 1944 that using trichlorethylene in the chloroform bottle resulted in too high a concentration which caused arrythmias [5].

In 1948, Gordon Ostlere (aka Richard Gordon) then senior resident anaesthetist at Hill End (Barts) reviewed 40,000 cases of Trilene administration. He considered Trilene useful for induction and maintenance of anaesthesia but agreed that administering it from a chloroform bottle led to overdosage and this was the cause of the arrythmias observed with its use [6]. Eventually a suitable bottle for use on the back bar of the Boyle machine was introduced. The amount of vapour administered was controlled by a lever on the bottle mounting, and adequacy of anaesthesia was judged by the clinical appearance of the patient, the smell of the vapour, and

remembering where one had put the lever last time. A Tritec vaporiser was later developed, but was not widely available for use.

The main features of trichlorethylene are well known [7]. These are summarised in Tables 1 and 2.

Table 1. physical and chemical properties of trichlorethylene

Halocarbon
Clear, colourless non-flammable nonexplosive liquid
Pleasant chloroform-like sweet smell
Specific gravity: 1.47
Boiling point: 87^{o}C
Vapour density: 4.5
Chemical formula: C_2HCl_3
Inflammable above 25.5^{o}C in concentrations of 10-64.5% (well above those used in anaesthesia)
Reacts with soda lime used in closed circuit anaesthesia
Decomposes in strong sunlight

It was not routine in those days to monitor the ECG during anaesthesia, so although arrythmias may have occurred, these were unrecognised, and must have been benign.

Table 2. Anaesthetic properties of trichlorethylene

Slow induction and recovery
72% absorbed when inhaled
Analgesia followed by anaesthesia when inhaled
Significantly less nausea than ether
Little effect on blood pressure
Tachypnoea
Cardiac arrythmias
Possible evidence of hepatotoxicity

Management of retinoblastoma

Barts had a famous surgeon, Hyla Bristow (Henry) Stallard, who in the 1924 Summer Olympics held in Paris won the bronze medal in the 1500 metres race as shown in the film "Chariots of Fire" (Stallard played by Daniel Gerroll in the movie). He was world famous for his management of retinoblastomas in babies and toddlers and was near retirement when trichlorethylene was being introduced [8].

Retinoblastoma is a rare malignant disease of the retina, usually in young children and about two in every five is now thought to have a genetic basis. Treatment at this time consisted either of cobalt plaques sewn onto the outside of the eye, done under anaesthesia in an operating theatre, or repeated treatments, by radiotherapy beam, usually three times a week for several weeks in a radiotherapy department. [9]

At Barts, the radiotherapy department was situated in the bowels of the earth, across a public road, distant from the children's ward and any other operating theatre. These children had to be kept completely still during the treatment, which meant that they had to be repeatedly anaesthetised.

The Anaesthetics Department policy at this time, at Barts, was that one trainee anaesthetist, SHO or registrar, should be detailed to adminter the entire series of anaesthetics to a given child.

AF's allocated child was a little girl about eight months old with a definite mind of her own. She would not agree to being anaesthetised until she had turned the light on over the fish tank in the waiting room.

Induction was done in the radiotherapy room as there was no anaesthetic room. As it was an inhalational induction with trichlorethylene, it was very slow. An orotracheal airway was inserted and a simple T-piece circuit with a double ended bag used. Gas flows were maintained high enough to ensure that any breathing round the airway did not affect adequate bag movement. A pulse meter was attached to either a toe or a finger.

There were no gas pressure measurements, no gas analysis, no accurate vapouriser, no scavenging and no spark-proof electrical sockets, and on the patient, no ECG, no pulse oximeter and no patient record.

The airway had to be maintained mechanically while the treatment took place. This was done by using a frame, as described by Browne, Boulton and Crichton [10]. All staff had to leave the room once the airway was secured, while the radiotherapy beam was on. This took three minutes, during which the child was watched on the black and white monitor. All that could be seen were the respiratory movements of the bag, and the pulse meter. This was terrifying for an anaesthetist, used to watching the patient very carefully. The doors to the treatment room were unlocked at the end of the treatment and the child given oxygen and then returned to the ward in a pram.

This was a lengthy process, taking a minimum of half an hour, all for three minutes of treatment, tying up a valuable radiotherapy unit for this time, and filling the whole area with anaesthetic gases. It had to be repeated three times a week for several weeks. Fortunately, very soon after, there was a therapeutic breakthrough, the introduction of ketamine.

Part II: Dissociative Anaesthesia with ketamine

The second part of this manuscript is experience for radiotherapy in children when ketamine was introduced into clinical practice. An observational study was carried out at the Barts followed by later experience. It is important to realise that this study was carried out very shortly after the time the technique involving the use of trichlorethylene described earlier was used. This happened at an interesting time as there was not only ketamine but propanidid, Althesin and the muscle relaxant pancuronium were also being or had been introduced recently.

Ketamine produces dissociative anaesthesia which is a state of catatonia, catalepsy, analgesia and amnesia. It may not mean loss of consciousness and is not a state of general anaesthesia. It is believed to confuse the sensory nerve impulses leading to the cortex and intracerebral communication [11]. It means that the anaesthetist (and surgeon) has to reset their mind from the situation under 'normal' general anaesthesia and it is probable that a number found this an unusual scenario.

Ketamine was introduced into anaesthesia in 1970 [12]. It has survived in practice since then due some of its special characteristics such as cardio-vascular stimulation and its broncho-dilating effect [13]. It has little effect on

respiratory reflexes but limited aspiration has been shown to occur [14]. However, one of its strengths is that the muscle tone of upper airways is maintained decreasing the possibility of respiratory obstruction. Increased salivation can occur and pre-administration of atropine is considered useful.

Ketamine is a derivative of phencyclidine. It is water and lipid soluble and is metabolised in the liver, its main metabolite having about 30% activity. It provides a dissociative state of anaesthesia which in adults has interesting side effects but less than phencyclidine. Phencyclidine is also a dissociative anaesthetic agent which was introduced in 1956 but banned in the USA in 1965 due to the high incidence of side effects [15]. These included paranoia, loss of body image/state, agitation, hallucinations and suicidal thoughts. Phencyclidine is only a recreational drug now and commonly known as angel dust.

Ketamine was introduced commercially in 3 dose strengths- 100mg ml^{-1}, 50 mg ml^{-1} and 10 mg ml^{-1}, the first two were generally used for intramuscular injection and the last for intravenous administration. In our practice only intramuscular injection was used for anaesthesia. The intravenous dose for induction is 2-4mg kg^{-1} and for intramuscular administration 5-15 mg kg^{-1}.

The incidence of side effects was low with ketamine and mainly in adults but hallucinations and a feeling of dread occurred [16]. One side effect was euphoria which did manifest itself in an adult in later practice. Why did it appear more tolerated in children than in adults? The belief at the time was that children with their imagination, and toys and games, related to and accepted the hallucinations whereas adults did not.

The Study

This was an observational study of ketamine anaesthesia in children requiring radiotherapy mainly for retinoblastoma but also other conditions [17]. The purpose of using ketamine was to provide anaesthesia while maintaining adequate nutrition in these children having repeated treatments over time.

The study was in a consecutive series of 17 children, 6 months to three and a half years old, who were administered ketamine intramuscularly on 173 occasions (ranging from four to 20 administrations). There were 10 patients with retinoblastoma and seven with other tumours. Treatment was given normally on alternate days (plus the weekends). The patients received a drink of milk at 07.00. The first 12 children received atropine at 08.15 before receiving ketamine whereas the other five received it with ketamine.

The first dose ranged from 7 to 15mg kg^{-1} and this was adjusted in future administrations (dose range 2.6-22.3 mg kg^{-1}).

The patients were given the drug in the Radiotherapy Department (RT) except for 2 nervous patients where it was given on the ward. The children were positioned for treatment with a pulse monitor attached. The patient and the monitor could be seen on the closed circuit TV. Sedation was satisfactory and the airway was maintained satisfactorily.

Supplementary doses of ketamine were given prior to treatment on 10 occasions due to movement, none were given once the treatment was started but on eight occasions radiotherapy was interrupted to reposition the child due to purposeless movement.

The children all received lunch or feeds at noon. Six children gained weight, five remained the same and in six the weight decreased, maximum decrease being 4.7% of body weight.

The study showed that ketamine was satisfactory in this situation for anaesthesia without any detrimental effect on nutrition. No apparent issues about emergence phenomena arose during recovery except in the early stages with one child who appeared restless. One possible weakness was that as the patients who had received ketamine were to be left undisturbed during recovery resulting in no data being available about the time to regaining consciousness. This is particularly difficult with ketamine due to purposeless movements. They were left in the care of the ward nursing staff during recovery which at that time at Bart's was the routine post anaesthetic care.

Post Study

The practice of anaesthetising the children with ketamine continued but some changes were made. The children were given ketamine in the ward and then transported over in their prams for treatment. One of the prams was always a resusci-pram. Up to three children could be anaesthetised and taken along the public street to the RT Dept. Imagine the looks the nurses with their prams got from working population (Smithfield) along the street! There were no issues other than on one occasion when the child moved before the injection was given and the needle went through the tip of the mother's finger into the child's deltoid. The mother nodded and the injection was continued. Some of the children realised what was going to happen and would start to cry.

There was not much to do once the injection was given. The children were watched for airway during positioning etc. The RT staff had a great deal of understanding as did the nurses, generally students, of patient care. Being outside the room the appearance and the pulse monitor were observed; this was the world before pulse oximeters.

Medical students came to watch these administrations and one student was so impressed by ketamine that when his child got a 'Sunday oven burn' he insisted that the child received ketamine for cleaning and dressing of the wounds.

Anaesthesia for assessment of the Retinoblastoma.

The children were assessed at different time periods after treatment to check the progression/regression of the tumour. These assessments were carried out under general anaesthesia in the eye ward theatre. The children were heavily sedated and given a standard 'gas' induction of oxygen, nitrous oxide and halothane. Once anaesthetised they were transferred to the theatre where anaesthesia was maintained using a Phillip's Airway with a Charles Cap to avoid intubation [18]. The ophthalmic surgeon would assess the tumour. He would compare the retina with a photograph taken on a previous assessment.

Ketamine was used on a child in the Plastic Surgery and Burns unit in a hospital with a RT Dept. Ketamine was also used in children who had

received ‘successful’ treatment of large burns and were having multiple operations with no immediate intravenous access. They were often distressed and it was not pleasant seeing them with all the contractures and scarring trying to escape our administrations as they had had so much pain and distress in the past. The drug was also used on occasional adult patients for immediate removal of burnt clothing and debridement. This was where the dissociative anaesthesia was shown well during one list with three adults. One, when moved to the operating table suddenly put all four limbs vertically like the cartoons of a dead cat. Another started singing and would obey requests for different songs although they had no recollection of surgery. Another adult showed euphoria. He had previously received ketamine for removal of his burnt clothes and debridement. He experienced a hallucination on the first administration about the nurse looking after him and he requested the same anaesthetic!

Animal anaesthesia.

Ketamine was used to anaesthetise a sheep for a surgical experiment. Unfortunately the operator, a Senior Registrar later a highly regarded surgeon, thought he would not wait for the anaesthetist to arrive so he gave the sheep what was a subclinical dose of ketamine. The sheep became confused and backed off under the lab bench where we had to crawl to administer another dose.

Later again we used ketamine intramuscularly to induce anaesthesia in two baboons prior to preparing them for cardiopulmonary bypass and multi-organ support therapy in a Cardiac Surgery Unit. The baboon support became headline news in the Sunday papers.

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Unexpected Deaths Under General Anaesthesia: The Story of Malignant Hyperthermia

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Unexpected fever during anaesthesia has been noted since as early as 1900 [1]. Case reports of patients dying after experiencing extremely high temperatures and convulsions were sporadic but noted throughout the following decades, and in his book entitled 'Inhalation Anaesthesia, A Fundamental Guide' published in 1937, Arthur Guedel included a section on postoperative hyperthermia [2].

However, it wasn't until 1960 when a student was hit by a car outside the Royal Melbourne Hospital, sustaining a fractured leg which required surgery, that this was investigated further. The patient was Ron Evans, who was aged 21 at the time. His mother rushed to the hospital upon hearing what had happened and was adamant he was not to receive a general anaesthetic, as ten of their family members had died under anaesthesia [3].

The anaesthetist for the list, Dr Jim Villiers, spoke to the family and ascertained that the deaths had likely been related to ether. He called the family's general practitioner as well as the Royal Children's Hospital for further information, as Ron's cousin had been safely anaesthetised there a few months previously [4]. Dr Villiers decided to proceed with caution avoiding the use of ether, instead opting for halothane [4]. He premedicated with pethidine 100 mg and atropine 0.6 mg and induced anaesthesia with thiopentone 250 mg. Anaesthesia maintained with nitrous oxide 2L min^{-1}, oxygen 1L min^{-1} and halothane, using a Boyle apparatus with closed circuit and soda lime absorption [5]. Despite this, the unfortunate result was a deteriorating patient who showed signs of cyanosis, hypotension, tachycardia and an extremely high temperature. The operation was quickly finished, the anaesthetic ceased and Ron was cooled down with packed ice from the cardiac theatre which happened to be down the corridor [3]. Fortunately, these measures meant that Ron survived and would eventually go on to be known as the first survivor of malignant hyperthermia.

The patient was referred to Professor Richard Lovell at the University of Melbourne School of Medicine, who asked Dr Michael Denborough to investigate due to his interest in clinical genetics. Dr Denborough felt this was ‘a previously unrecognised inborn error of metabolism’, but initial tests were all negative, and the cause of the deterioration unclear [4].

Denborough decided to dig deeper into Ron’s family history, including both relatives who had received general anaesthesia and those who had not. He mapped out a family tree, documenting an apparent autosomal dominant pattern of inheritance with possible variable penetrance in those who had died following general anaesthesia. Three family members were of particular interest. All three were females aged between 12 and 39, who had had surgical procedures under general anaesthesia and initially seemed to have recovered well, returning to the ward, only to develop convulsions which proved to be fatal approximately half an hour later. In two of the cases, temperatures were taken and found to be 43°C and 42°C. No cause for this was identified at the post-mortem [5]. It was Denborough who is attributed with first identifying malignant hyperthermia, but at the time it was a disease without a cure.

Not long afterwards, in 1967, H R Snyder Jr was working at Norwich Eaton Laboratories specialising in urological antibiotics, and was the first person to publish on what he thought was a new muscle relaxant [6]. Dantrolene had resulted from the insertion of a phenyl ring into nitrofurantoin. It was fed to rats and mice, who when revisited the following morning were noted to be paralysed, but all physiological parameters remained normal. The animals had an imprint of the cage grill on their abdomens suggesting they had been pushed up against the cage for some time without moving. The mode of action was unknown, however, and Keith Ellis, a research scientist with a background in skeletal muscle physiology, was employed to find out [7].

Ellis conducted a number of experiments along the neuronal tract to identify where dantrolene worked. Over several years Ellis narrowed down dantrolene’s action to the cellular level and in 1972 published a paper hypothesising that the mechanism of action was directly on skeletal muscles, and specifically inhibition of calcium release [8].

Nevertheless it wasn’t until the following year that Ellis saw a

communication about a syndrome of muscle rigidity and sudden death in Landrace pigs, highlighting calcium release as the cause. He immediately recognised the role dantrolene could play, as until this point it was ‘a drug looking for a disease’. He wrote to several researchers interested in malignant hyperthermia, but received only one response from Gaisford Harrison in South Africa [7]. Of eight Landrace pigs where malignant hyperthermia was induced, seven survived after being given dantrolene. Despite this, after publication in the British Journal of Anaesthesia there was only one tangential reference to Ellis’ involvement [9].

Although dantrolene appeared promising in the management of malignant hyperthermia, further steps were required to introduce it into clinical practice. Dr Mary Kolb was instrumental in organising clinical trials in 1976. Sixty-five institutions took part, and eleven patients were treated successfully; eight who were judged to have definitely had malignant hyperthermia, and an additional three who probably did [10]. The drug was approved for clinical use in August 1979 and mortality from malignant hyperthermia has dropped from around 70-80% to 15% [11].

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How have animal studies and veterinary anaesthesia shaped the way we practise today?

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Since ancient history there have been records of anaesthesia performed on both humans and animals with many developments have gone hand in hand [1]. The practice of human and veterinary anaesthesia today shows many similarities ranging from equipment to pharmacology and even to recovery principles [2]. I would argue that veterinary and human anaesthesia are more like two peas in a pod rather than distant cousins. They have developed synergistically and still have a lot to learn from each other.

The contribution to human medicine from studies performed on animals is both extensive and well-known. Fields that have their basis in animal studies include anatomy, genetics, infectious diseases and the discovery and development of vaccines, the development of joint prosthesis and, of course, anaesthesia [3].

There is a huge ethical debate surrounding animal studies and animal testing. Speaking purely from a historical perspective, some may argue that the contribution and the sacrifices made by these animals have enabled development in medicine for both humans and animals that might not have been otherwise possible. The contribution these animal studies have made and some legislation that has been put in place to improve the welfare of these animals are discussed in this paper..

Galen of Pergamon was a Roman and Greek surgeon, physician and a philosopher. During the second century, he reported on the performance of tracheostomies on animals 200-300 years earlier, and it is reported that he himself inflated the lungs of dead animals using

bellows [4,5].

Andreas Vesalius, a Belgian anatomist, was the first to write a clear description of airway management in resuscitation of animals. He described the use of a tracheostomy and bellows to resuscitate a dog in his notable series of books, *De Humani Corporis Fabrica Libri Septem* in 1543 [6]. He wrote "that life may in a manner of speaking be restored to the animal, an opening must be attempted in the trunk of the trachea, into which a tube or reed or cane should be put; you will then blow into this, so that the lung may rise again….and the heart become strong" [6]. Atonio Brassavola was an Italian physician, who was the first to record a successful tracheostomy on a human. The patient had been suffering from a laryngeal abscess causing obstruction and recovered following surgery [4].

Robert Hooke, a respected scientist and the Curator of Experiments at the Royal Society of London, demonstrated during a meeting that the heart of a dog would beat normally and the dog could be kept alive if the lungs were inflated intermittently using bellows through a pipe entering the dog's trachea [7].

Whilst John Snow was researching techniques for the resuscitation of the stillborn, he performed an experiment on a guinea pig following drowning and demonstrated that artificial ventilation via tracheostomy could restart cardiac contractions [8]. John Snow's input also extends to the delivery of anaesthesia via an airway - he described the use of a tracheostomy to administer inhalational anaesthesia to animals, and was likely one of the first to do so [4].

Dr Arthur Guedel and Professor Ralph Waters, two eminent American anaesthetists, developed the cuffed endotracheal tube and famously performed the 'dunked dog' experiment on Guedel's family dog in order to prove that the inflatable cuff was effective in protecting the trachea from aspiration of water [9]. They sedated the dog, intubated him with a cuffed endotracheal tube and then submerged him in water.

The dog survived the experiment and was later affectionately known as ‘Airway’ [10].

The inhalational agents whose popularity sky-rocketed in the 19th century, were primarily utilised as analgesic and euphoric agents. At the beginning of the twentieth century, the idea of ‘anaesthesia’ to facilitate surgery had not yet been born. Nitrous oxide was discovered in the late 18th century, and Sir Humphry Davy’s book published in 1800, *Researches Chemical and Philosophical; Chiefly Concerning Nitrous Oxide,* described his experiments on a number of animals including guinea pigs, kittens, rabbits, mice and even, as he described it, a ‘stout and healthy young cat’ [11].

There are numerous reports of the first discovery of ether, but the most commonly cited initial account was recorded by German botanist and chemist, Valerius Cordus in 1540 [12]. He termed it “sweet oil of vitriol”. There are reports at the time of its use by Paracelsus, a Swiss physician and chemist, as an anaesthetic - he stated that it put chickens to sleep when added to their feed [13]. However, the use of ether in the following three centuries was primarily as a recreational drug due to its ability to provide euphoria and excitement [12].

William Morton, an American dentist, famously experimented with ether on a human patient prior to tooth extraction in 1846. However, what is less commonly reported were his preceding experiments on animals on his farm, which enabled him to witness the anaesthetic properties of ether, thus informing its use in humans [14].

In 1824, Henry Hickman, an English physician, performed experiments on dogs in which he made them breathe carbon dioxide and observed the ‘suspended animation’ that ensued - the dogs were able to tolerate surgical procedures including amputation of their ears, without suggesting that they were in pain [15]. He realised that if he could replicate this in humans, it could facilitate painless surgery. In hindsight, this ‘suspended animation’ was likely just a carbon dioxide

narcosis! His work was widely criticised by the scientific community in the UK and in France including in an article that was published in The Lancet entitled *'Surgical Humbug'* [16]. He was also criticised for the inhumane techniques used during his experiments - the antivivisection movement was gaining power at this time. In hindsight, however, Hickman was recognised as the first person to postulate the idea of anaesthesia rather than just analgesia to facilitate surgery [17].

Sir James Young Simpson is reported trying chloroform on himself and then on rabbits in 1847 and his work was reprinted in veterinary literature [18]. Jean Pierre Flourens tested chloroform on animals and reported its anaesthetic effects [19].

The development of halogenated anaesthetic agents began with halothane. Charles Suckling and James Raventos, who were both scientists working for Imperial Chemical Industries (ICI) Pharmaceuticals, played a pivotal role in the discovery and experimentation of halothane as an anaesthetic agent and trialled it on a number of different animal species, which showed it was easy to use, quick-acting and had minimal immediate side effects [20]. Michael Johnstone went on to lead the first clinical trial of halothane at the Manchester Royal Infirmary in 1956 [21].

Potent agents with powerful skeletal muscle paralysing properties had been used for centuries in South America as an arrow poison. Experiments were performed in the early 19th century demonstrating that animals could be resuscitated following an injection of curare, providing their lungs underwent ventilation [22]. British explorer, Charles Waterton, had become fascinated with the properties of these agents and collaborated with Sir Joseph Banks, president of the Royal Society, Benjamin Brodie, Physician and Surgeon, and William Sewell, the Director of the London Veterinary College. They undertook experiments on donkeys that demonstrated similar outcomes to the previous experiments, and much interest from the

scientific community followed [22, 23].

In 1900, J. Pal, a physiologist in Vienna, was studying the effects of physostigmine on peristalsis of the gut. The dog he was experimenting on had been paralysed with curare, and to Pal's surprise, started breathing spontaneously after the physostigmine was administered [10, 24]. This is likely to be one of the first steps towards the development of neuromuscular blockade reversal.

Karl Koller was an Austrian ophthalmologist who experimented with different topical solutions for eye surgery including morphine and chloral hydrate, prior to utilising cocaine. He applied cocaine crystals to the eyes of a dog in his laboratory and noticed analgesia to even sharp touch. He then tried the same in his own eyes before utilising this on patients. [25].

In 1885, Dr James Corning, an American neurologist, injected cocaine between the spinous process of a dog and noticed the dog's hind legs went weak, but that the effects wore off and he later regained motor function [10]. He postulated that this was a spinal anaesthetic, but there was debate about whether the had entered the subarachnoid space and it was likely that this was, in fact, the first epidural block [26]. Four years later, in 1889, August Bier, performed the first known spinal anaesthesia by injecting cocaine into the subarachnoid space [27].

Theodore Tuffier, a French surgeon, was renowned for popularising spinal anaesthesia in France, and demonstrated the sympatholytic effect associated with injection of local anaesthetic into the subarachnoid space of dogs and cats [10, 27]. This finding was later reproduced by other scientists and physicians, including Smith and Porter of Harvard medical school in 1915, who also tested spinal anaesthesia on dogs and cats. They wrote "As a rule beneficent, spinal anaesthesia is nevertheless by exception open to a grave and sudden danger. In the course of surgical procedures otherwise completely

successful, the vasomotor apparatus may suddenly give way. The fall in blood pressure is immediate, sometimes profound, always disquieting. Nor can the surgeon predict in which patient it might appear" [28].

The concept of animal sentience - the idea that animals have the capacity for emotion and affect - had been documented by philosophers including Leonardo da Vinci and Erasmus. However, the concept was not widely accepted by scientists and lay people until the Enlightenment Period of the 19th century [29]. English philosopher, Jeremy Bentham, argued that there was no justification for treating animals differently from humans when it comes to pain - in 1823 he wrote "The question is not, Can they *reason*, nor can they *talk*? but, Can they *suffer*?" [30].

The anti-vivisection movement had started and was spearheaded by a number of women, including Anna Kingsford, the first English woman to obtain a degree in medicine [31]. The role of anaesthesia in animals was being advocated by veterinarians including Sir Frederick Hobday and Edward Mayhew as a humane practice [32]. George Dadd, an English veterinary surgeon working in America, wrote in his equine veterinary manual of 1854 about the use of ether anaesthesia for veterinary surgery [33]. However, it took almost another hundred years for it to become routine amongst veterinarians.

Throughout Europe, animal testing in medical research gradually increased throughout the 19th and the early 20th centuries. This may be due in part to the broadening availability of anaesthesia and analgesia for this purpose. Legislation has played a vital role in promoting the necessary protection of the animals used in medical research. One of the first pieces of legislation in the world protecting animals from deliberate acts of cruelty was *The Cruel Treatment of Cattle Act 1822* [34]. This legislation made it a crime to treat some domesticated animals cruelly or inflict unnecessary suffering on them.

The next major development in the Western world was *The Cruelty to Animals Act 1856* [35]. This was the first legislation aimed at regulating experiments on animals. This was followed by numerous international regulations, some of which now mandate the use of anaesthesia and analgesia in laboratory animals. The regulations we follow now are set out in *The Animals (Scientific Procedures) Act (ASRA) 1986* [36]. The ASRA states that animal procedures can only take place in research institutes or companies with appropriate animal accommodation and veterinary facilities; and that testing on animals is only allowed if no other reasonable alternative is available.

The delivery of the first veterinary anaesthetic was likely performed by the director of the London Veterinary College (now the Royal Veterinary College), William Sewell [32]. Later on in that year, Edward Mayhew, a highly renowned veterinarian, published two papers in the journal '*The Veterinarian*' entitled '*Inhalation of Ether Fumes*' and '*The Vapour of Ether*'. Edward Mayhew undertook his experimentation a little differently from his physician colleagues - he first trialled ether on himself and *then* on dogs [32]!

In more recent years, a more reciprocal relationship has been forged in which veterinary anaesthesia is learning from human anaesthesia. The evidence-based medicine that we practise today has been relatively commonplace since the 1990s, with foundations dating back to the 1960s, and terms such as "critical appraisal" being utilised amongst doctors since the 1980s [37]. The onus on evidence-based medicine within most higher education institutions is apparent. Veterinary medicine has begun to follow suit over the last 15 years.

During and after veterinary anaesthesia, higher rates of mortality have been displayed than those in human anaesthesia. This was recognised by the Association of Veterinary Anaesthetists (AVA) and they have formulated patient safety checklists and general anaesthesia recording charts which are recommended by the the RCVS Practice Standards Scheme [38]. There are some similarities between the Association of

Anaesthetists of Great Britain and Northern Ireland (AAGBI) standards and AVA standards including record-keeping, the use of safety checklists, equipment checks and the presence of an anaesthesia trained clinician in theatre [39].

Supraglottic airway devices have been used in human anaesthesia since the early 1980s following the development of the Laryngeal Mask Airway by Dr Archie Brain. Airway management in animals had been largely done using endotracheal intubation or face masks until the manufacturing company, Docsinnovent, developed the v-gel - a supraglottic airway device for cats and rabbits [40]. This device has been helpful in avoiding some of the complications of endotracheal intubation in these animal species. A newer v-gel suitable for dogs has also been developed.

The 'One Medicine, One Health' principle advocates for knowledge-sharing and a more collaborative approach to medical progression in both human and veterinary medicine. There are numerous recommendations for how a positive change can be brought about to facilitate developments in both human and veterinary anaesthesia [41,42].

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Coming out of a bad trip:
The turbulent history of ketamine and its promising future

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Ketamine is a unique anaesthetic agent, possessing dissociative properties unlike any other anaesthetic agents. It is a versatile drug that also has many uses outside the operating theatre, gaining the interest of researchers in various fields ranging from psychiatry to chronic pain. Unfortunately, stigma has followed ketamine after its notorious link to recreational drug use that led to it being classified as a controlled substance. However as new findings emerge, ketamine is slowly getting 'rehabilitated'. It is imperative to delve into its eventful past to gauge the future of ketamine.

Before ketamine, there was phencyclidine

Although ketamine was synthesised in 1962, its history starts in the 1950s with research into the analgesic properties of cyclohexylamines at Parke-Davis and Company's Detroit laboratories that led to the discovery of phencyclidine in 1956. Phencyclidine emerged during clinical trials focusing on developing a new anaesthetic agent. It was found to be an effective analgesic that could allow laparotomy in monkeys [1]. However, there were concerns regarding recovery as the test animals became extremely hyperactive, and some even exhibited a cataleptic state [2].

The first testing of phencyclidine in humans

Phencyclidine (PCP) was first tested on surgical patients in 1958. It was found to have a favourable cardiovascular profile, and patients maintained their own airway intraoperatively [3]. However, an unusual postoperative phenomenon of patients being unable to feel their own limbs was noted. It was concluded that phencyclidine was responsible for causing 'centrally mediated sensory deprivation syndrome' and postoperative delirium [4,5]. Its use as an anaesthetic agent was discontinued in 1965 [5].

The birth of ketamine

Despite its now illicit status, curiosity around PCP and its unique pharmacological profile meant that it was still explored but in the form of a different chemical derivatives by Parke-Davis pharmaceuticals.

In 1962, Chemical consultant Dr Calvin Stevens synthesised a PCP derivative which was not only short acting, one-tenth the potency but still worked effectively as an anaesthetic with less psychiatric side effects. This PCP derived compound consisted of a ketone paired with an amine and thus ketamine was born [6].

Mechanism of action of ketamine

Ketamine achieves its dissociative anaesthetic and analgesic properties by blockage of the N-methyl-d-aspartate (NMDA) receptor. NMDA receptors are found at excitatory synapses and respond to glutamate, a primary excitatory neurotransmitter [7]. Interference with glutamate results in an inhibitory state that achieves an anaesthetic level of unresponsiveness and dissociation. Ketamine blocks sensory input to the higher centres of the central nervous system therefore affecting how pain and emotions/memory are processed [8].

Ketamine is much less potent than PCP as it is binds weakly to NMDA receptors and so is short acting also. This likely explains its reduced side effect profile especially in terms of the emergence reactions [9].

The first testing ketamine in humans

Following animal studies, ketamine progressed to studies in humans in 1964. Ten prison volunteers at the Jackson State Prison in Michigan were selected for intravenous administration of ketamine. They described a disconnection from their bodies and limbs, and so the term ‘dissociative anaesthesia’ was coined [10].

The first study on the use of ketamine humans was published in *Anesthesia and Analgesia* in 1966, investigating its administration as a general anaesthetic agent in 130 surgical patients. Patients were able to maintain

their own airway adequately, but unlike PCP there was significantly less prolonged postoperative delirium [11].

Ketamine gets FDA approval and goes to the battlefield

Following successful human clinical trials, ketamine was approved for use as a general anaesthetic/sedative agent by Food and Drug Administration (FDA) in 1970 under the trade name Ketalar®[12]. Like PCP, Ketalar was sold by Parke-Davis.

With the timing of the Vietnam war correlating with the FDA approval for ketamine, it was the anaesthetic of choice in the battlefield due to not only its fast and short acting nature but sympathetic activation effect at induction. This is essential when anaesthetising soldiers who would have sustained significant trauma and required emergency surgery quickly. The fact that ketamine could be administered intra-muscularly was lifesaving especially in military patients where IV access can sometimes be very challenging secondary to trauma or haemodynamic compromise. These unique anaesthetic properties that ketamine possesses explains why ketamine is still a popular anaesthetic in trauma and battlefield medicine to this day.

Ketamine in vulnerable paediatric and geriatric patients

Ketamine proved to be a valuable anaesthetic agent especially in vulnerable paediatric patients. This is mainly due to its short action and ability to preserve cardiovascular stability [13]. The sympathomimetic and bronchodilator effects of ketamine are useful in the elderly patients. Bronchodilating properties of ketamine make it useful in patients at risk of bronchospasm such as those with asthma and chronic obstructive airway problems. The emergence reaction characterised by hallucinations and sensory dissociation was found to be adequately controlled with intravenous propofol or a benzodiazepine [14].

In terms of the pharmacodynamics of ketamine, it activates the sympathetic nervous system resulting in increased cardiac output, increased heart rate and increased blood pressure [15]. This is because ketamine inhibits uptake of catecholamines while stimulating noradrenergic neurones [16]. In terms of the mechanism of action of ketamine in producing bronchodilation, this is

thought to be secondary to ketamine's anti-inflammatory properties. This impacts on the inflammatory cascade that leads to bronchospasm especially in asthmatic patients.

Studies on the use of ketamine in children showed that this population experience the delirium-like reaction less frequently especially with intra-muscular administration. The rationale behind why paediatric patients did not seem to be disturbed by ketamine's emergence reactions was mainly how children perceived their environment differently to adults. It was found that as the patient aged, their risk of negatively experiencing unique sensory isolation with ketamine increased as well. For many of the paediatric patients, it was found that very few had any recollection of the post-anaesthetic anxiety.

The rise of recreational use of ketamine

As it was quickly becoming a popular anaesthetic drug with its favourable sympathomimetic profile, there was also a sudden increase in ketamine being used as a recreational drug. Ketamine abuse started during the Vietnam war era as it was used frequently as an anaesthetic to treat wounded soldiers. It was the drug of choice due to its rapid onset, easy administration and dissociative nature making it excellent for treating mass casualties on the battlefield. Alongside the Vietnam war in the 1970s, illicit use of ketamine began to spread in the United States of America amongst individuals trying to experience the dissociative high and escape the post-war trauma [17].

In the 1980s, Ketamine began to appear recreationally worldwide as it started to become associated with the up-and-coming rave culture. Drugs of abuse at raves were usually a stimulant like cocaine, and so ketamine quickly became the choice agent as the high with cocaine could be overwhelming and too intense. Ketamine was also found to be a useful drug to facilitate overcoming the notorious 'come-down' when stimulant high began to wear off and cushioned the associated dysphoric 'come-down' feeling [18].

Stigmatising ketamine:

With the rise of abuse in the 1970s, ketamine began to develop a stigma and a reputation as a dangerous drug with potential to be abused and because of

its links to psychological addiction. The potential of ketamine for abuse and the rise in deaths due to recreational drugs resulted in ketamine becoming a Class III substance under the US Controlled Substance Act in 1999 [19].

The role of ketamine in poorly resourced environments

Despite its stigmatisation, ketamine is still in the list of WHO essential medications as an intravenous anaesthetic. It was also added to the WHO model list of essential medications in the paediatric population. As described by WHO, ketamine was added for its ability to provide safe anaesthesia and analgesia [20].

As a result of the need for ketamine as an anaesthetic agent in low resource countries, WHO Expert Committee on Drug Dependence advised that ketamine should not be controlled under the international drug control conventions. Its relative safety profile means that safe anaesthesia can be provided in situations where there is a lack of experienced anaesthetists, anaesthetic equipment and in some extreme situations – a lack of electricity and running water. This would allow for ready access when needed in crisis situations, in theatres of developing countries worldwide as well as within veterinary medicine.

Ketamine – a new approach to treating depression?

Despite its classification as a controlled substance in some countries, ketamine has gained interest in the early 2000s for management of treatment resistant depression. The antidepressive properties of ketamine were first noted in 1975 in animal models [21]. Since ketamine was confirmed to be a NMDA receptor antagonist in 1983, more animal studies into its use in treating depression showed that it was able to manage depressive behaviours in rodents.

The first randomised controlled trial looking into the antidepressant actions of ketamine was published, in 2000, in The Journal of Biological Psychiatry. In this study, seven patients were subjected to two days of IV ketamine at a subanaesthetic dose or a placebo. This randomised double-blind control trial was conducted over two test days only. Findings showed that there was significant decrease in the patient's depressive symptoms over a short period

of time [22]. Unlike other antidepressants, ketamine was found to be faster acting with significant antidepressive effects noted within hours [23]. One study found that in some instances, a single dose of ketamine produced an instant antidepressive effect even in treatment resistant cases [24]. Despite these findings, ketamine was not approved for use as an antidepressant until years late in 2019 when the FDA approved ketamine under the trade name Spravato as an intranasal spray. Despite FDA approval, it was only marketed for use in treatment-resistant depression and suicidal ideation [25].

Ketamine – hope in chronic pain?

Given its background as an anaesthetic agent, there has been extensive research into effects of ketamine in managing chronic pain. One of the main issues with managing chronic pain is the fact that it has relied mainly on analgesia with opioids. Regular opioid use comes with several consequences including addiction, tolerance and gastrointestinal symptoms. In chronic pain patients, it is important to have options for when opioid medication has been exhausted and symptoms are still ongoing.

Research into the use of ketamine as a novel agent in chronic pain began in 1994, looking mainly in patients with various chronic pain syndromes such as fibromyalgia and postherpetic neuralgia. There were studies looking into its use in patients with complex regional pain syndrome. This cohort of patients was given IV ketamine and found to produce a significant improvement in the pain scores [26].

It has been shown that subanaesthetic doses of ketamine not only provide analgesia but also enhance the effects of opioids by acting on the opioid receptors. This is particularly promising as theoretically it would allow for reduced opioid requirement in chronic pain patients and potentially reduce the risk of opioid tolerance [27]. It is theorised that ketamine potentially works well in patients with chronic pain due to the overlap and close link between chronic pain and depression. In addition, as an NMDA receptor antagonist, ketamine has been found to inhibit the ‘wind-up’ phenomena which is a ‘frequency-dependent increase in the excitability of spinal cord neurons’ [28].

What does the future hold for ketamine?

Over 50 years later, the curiosity around ketamine is ongoing. Ketamine has proved itself over the decades to be an extremely versatile drug. Starting as an anaesthetic drug that hoped to offer a safer anaesthetic experience for patients, it has evolved into potentially the next up-and-coming anti-depressant and alternative solution to chronic pain sufferers.

Its unique pharmacological action allows it to induce a sufficient level of unconsciousness without cardiovascular compromise. This continues to be invaluable in low resource countries and crisis situations that lack equipment and trained medical personnel. Therefore, despite the development of new anaesthetic agents, ketamine continues to be world-wide first line choice for ensuring low risk anaesthesia in developing nations.

Ketamine has truly made a comeback into the world of medicine and continues to be at the front of clinical research even after being branded as a drug of abuse. It is exciting to see what unresolved issue in the world of medicine and surgery ketamine will tackle next!

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The history of local anaesthesia: a story of missed opportunity, self-experimentation, and addiction

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The introduction of general anaesthesia in 1844 by dentist Horace Wells [1] was a pivotal moment for the advancement of surgical techniques. However, with more widespread use of chloroform and ether came more awareness of the risks, especially when used for minor surgery [2].

Four years after the introduction of general anaesthesia, came reports that a 15-year-old girl named Hannah Greener had died as a result of a general anaesthetic given for removal of a toenail [3]. Unsurprisingly this caused great concern amongst the general public. Public support further diminished after John Snow published an article describing 21 deaths due to chloroform anaesthesia [4]. There was a real need for less invasive anaesthetic techniques.

One might argue that the development of local anaesthesia goes back as far as the ancient Egyptians. Paintings from the year 2500 BC discovered in the ancient Egyptian tombs of Saqqara illustrate devices used to compress peripheral nerves [5]. Interestingly a very similar concept was then revisited thousands of years later in 1784, when James Moore developed clamps designed to compress the peripheral nerves, and thus reduce signal transduction and therefore pain [6].

Another recurring theme throughout history is the use of cold to numb peripheral nerves. The earliest evidence of this is from Anglo-Saxon monks in 1050, who recommend the submersion of a limb in cold water to facilitate superficial surgery [7]. In 1807 during the Russian invasion by Napoleon, Napoleon's surgeon-in-chief Dominique Larrey observed that the extremely cold conditions experienced by the soldiers, reduced the pain of frostbite and gangrene [8].

British surgeon James Arnott further expanded on this idea. He developed a bladder in 1848 in which to store the cold water to decrease the temperature of the tissue in a more uniform manner [9]. The duration of the freezing had

to be limited, due to the risk of necrosis, which somewhat limited its utility in surgery more invasive than the removal of ingrowing toenails or excision of an abscess. Cooling sprays are still used today for surface anaesthesia for cannulation or suturing, as an alternative to the use of local anaesthetic drugs.

The drive to develop local anaesthetic techniques was partly fuelled by an awareness of the limitations and risks of general anaesthesia [2]. It is therefore perhaps unsurprising that some of the first agents tested for local anaesthetic properties were general anaesthetic drugs, including chloroform and nebulised ether. Interestingly, many of the agents used exerted their effects not through direct local anaesthetic action, but through the cooling effect on the tissues as a result of the latent heat of vaporisation [10].

James Young Simpson, Scottish obstetrician and the first to use chloroform for general anaesthesia, was interested in whether chloroform could provide local anaesthesia when applied topically. Simpson demonstrated that immersing a hand in a container containing chloroform vapour, resulted in direct anaesthetic effects on superficial nerves [11]. It is thought that Simpson first coined the term local anaesthesia, although as discussed, he was not the first to use the technique [12].

All of these inventions were however made practically obsolete by the later discovery of cocaine which changed the face of local anaesthesia. Cocaine originates from the leaves of the shrub *Erythroxylon coca*, found in South America. It is thought that the earliest use of the coca leaves dates back to 3000 BC. South Americans who chewed the coca leaves found that they had the energy to work for longer, felt a rather pleasant sensation and not only that, did not require as much food as they did not experience hunger [13]. This is not surprising now that we know these leaves to contain cocaine.

It wasn't until Italian explorer Amerigo Vespucci voyaged to America in 1504, that word of the coca leaves and their potentially beneficial properties spread to Europe [14]. The use of cocaine was then actively encouraged by the catholic church and was thought to provide many medicinal benefits, with leaders of the church using it themselves [15]. Amongst those noted benefits, there was no mention of its utility as a local anaesthetic agent.

A key turning point was the importation of coca leaves by an Austrian Von Scherzer in 1850 [16]. This enabled study of the coca leaves, and the isolation of cocaine from the leaves. It was observed that injecting cocaine resulted in insensitivity in rats, frogs and calves, but this was not immediately translated into clinical practice [14].

Austrian Karl Koller is credited with introducing cocaine into clinical practice. He performed the first procedure in 1884 using cocaine as a local anaesthetic when he applied it to the cornea to facilitate glaucoma surgery [17]. News of Koller's work spread far and wide and was a key trigger of widespread interest in regional and local anaesthesia. The first nerve block was described the same year as Koller's use of cocaine to facilitate eye surgery [18].

Along with more widespread use of cocaine came reports of toxic cardiovascular and central nervous system effects, with reports of several deaths in 1887 [19]. There were also reports of its highly addictive effects.

Local anaesthesia with cocaine was still somewhat limited by its short duration of action of only approximately 15 minutes. American neurologist Corning demonstrated that the duration of action of cocaine could be increased by applying a tourniquet more proximally on the arm to the site of cocaine injection [20].

The addition of adrenaline to cocaine further improved its safety profile and its duration of action, due to its vasoconstrictive effects reducing systemic absorption [21]. Although methods had been developed to prolong the duration of action of cocaine, there was still a desire to find longer acting and safer agents. Lidocaine was synthesised in 1948 and enabled longer duration of action with fewer side effects [22].

The development of local and regional anaesthesia as we know today relied upon not only the discovery of local anaesthetic drugs, but also the invention of the needle and syringe to deliver the drugs to their site of action within the tissues. Advancing knowledge of anatomy and pain pathways was also integral. These developments certainly did not occur overnight but are a result of many years of research and experimentation, with some missed opportunities along the way. This wouldn't have been possible had it not

been for the dentists and surgeons of the past who frequently experimented on themselves, sometimes costing them their careers and lives due to the development of addiction.

(*Author's note: this is an extended abstract of the presentation at the HAS meeting in Llandudno, the definitive manuscript will be published at a later date*)

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History of Anaesthesia as an Independent Specialty in Pakistan: 1947-2023

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Background

Pakistan, second largest country in South Asia, is the world's fifth most populous country with a population of 241.5 million people and 33rd-largest country area wise with 881,913 square kilometres (340,509 square miles). Anaesthesia as an independent discipline has been evolving since Pakistan came into existence in 1947 after getting freedom from British colonial rule. Administrative units of Pakistan include four Provinces (Punjab, Sind, Khyber Pakhtunkhwa, and Baluchistan), Islamabad capital territory and two administrative territories of Azad Jammu and Kashmir and Gilgit-Baltistan.

The aim of this history writing is to provide an overall journey of Anaesthesia in Pakistan from 1947 till today. This would help us recognize the scope of Anaesthesia and predict the current and future challenges for its advancement as an independent specialty in Pakistan.

Journey of Anaesthesia Over the Years:

The major challenge of historical research revolves around the problems of sources, knowledge, explanation and objectivity. The contents of this write up are based on in-depth literature and website review and information shared by our living legends in the discipline of Anaesthesia from public and private institutions across the country.

Based on historical events, the development of Anaesthesia in Pakistan can be categorized as

- Prior to 1947
- 1947-1972: Mono- Anaesthesia
- 1973-1989: Balanced Anaesthesia
- 1990 – 2000: Smart Anaesthesia
- 2000- till today: Precision Anaesthesia

Prior to 1947:

Prior to 1947, anaesthesia was required for a very limited number of surgeries and mostly delivered by the medical doctors called "Assistant Anaesthetists" who were neither properly trained nor qualified in anaesthesia but had the skills of managing airways and interpreting physiology. Dentists have also been administering anaesthesia for some common surgeries at the big teaching hospitals. Open-drop anaesthesia with ether (diethyl ether) without any muscle relaxants and opioids was the anaesthesia technique for all types of surgery.

Anaesthesia was not a recognised independent discipline when Pakistan came into existence. Dr KE Madan was the only Lecturer in Anaesthesia working at King Edward (KE) Medical College, Lahore (Province of Punjab). His famous book "Elementary and Advanced Anaesthesia", published in 1930, was the only reference book in the early days of Pakistan.

1947-1972: Mono-anaesthesia

During this era, open-drop anaesthesia with a single agent was the most commonly used technique. Anaesthesia equipment comprised of assorted Schimmelbusch masks, gauze squares and bottles of pure ether or chloroform. At some places a mixture of ether: chloroform in a 3:1 ratio was also used. Induction of anaesthesia was either performed with ether or with intravenous thiopentone using reusable glass syringes and metallic needles.

Majority of abdominal and pelvic surgery was performed under general anaesthesia (GA) using red rubber endotracheal tubes (ETT). These tubes were washed, boiled, and re-used for the next intubation. Anaesthesia in the teaching hospitals was generally maintained with ether or trichlorethylene (Trilene) using the Boyle bottle. In peripheral hospitals, an indigenous apparatus consisting of a small tin canister containing ether in it was used. Air and oxygen were passed over it and then delivered to the patient either using a face mask or the ETT.

Low-cost portable machines became available in later years. EMO (Epstein-Macintosh-Oxford) apparatus without any temperature compensation was commonly used along with a Heidbrink valve. Oxford Miniature Vaporiser

(OMV) was erratically available in Pakistan during this era. As the dose of ether or trichlorethylene was unmonitored, the patients' delayed awakening was not uncommon.

Spinal anaesthesia using 18G reusable needles was another common anaesthetic technique used for gall bladder and renal surgery. Cinchocaine was the only local anaesthetic agent available. The big size containers full of ice were kept in the operating theatre to maintain the temperature.

Two fingers on the pulse was the only intraoperative monitoring available during anaesthesia. Mechanical ventilators were not available, and patients were allowed to breathe spontaneously or ventilated manually by hand. No evidence of recovery room provision was found during this era. There was no anaesthesia record keeping, however recording of heart rate, blood pressure and respiratory rate was started in late 1950s.

The major barrier in promoting discipline of anaesthesia was a limited hospital budget that never supported expansive anaesthesia machines, ventilators, or even human resources.

The journey of Anaesthesia in Pakistan is filled with variety of courageous, determined and exceptionally brilliant anaesthetists. Brief biographies of some of them are given here:

- Professor Rustam Ali Nabi was a pioneer of anaesthesia in Pakistan. He was a graduate of Medical School at St. Bartholomew's Hospital, London. He started his carrier in 1948 as an assistant anaesthetist at King Edward Medical College (KEMC) Lahore and later proceeded to England after 6 months for Anaesthesia training. He returned to Pakistan in 1953 and joined KEMC and Mayo Hospital Lahore as Assistant Professor and the Chief Anaesthetist. He was appointed as the first Professor of Anaesthesia in Lahore in 1959 and started a diploma program at the University of Punjab in 1960.

- Dr. Hussain Ahmed was a graduate of Madras Medical College, India. After migration from India, he joined Civil Hospital Karachi (CHK) in 1949 as a Medical Officer. He went to Copenhagen on WHO scholarship and obtained his diploma in Anaesthesia (DA)

from Copenhagen as well as from the UK. He subsequently returned to CHK and established the Department of Anaesthesia becoming the first Chief Anaesthetist in 1953. He later became the first Professor and Head of Anaesthesia at the Dow Medical College (DMC) & CHK and remained there until 1976. Dr. Hussain Ahmed was also the first Anaesthetist from Pakistan to obtain FFARCS from the Royal College of Surgeons of England.

- Two other physicians, Dr Abdur Rehman Mohammad Attar from Karachi and Dr Anis-Ur-Rehman Khan from the Armed Forces, were identified by the Public Service Commission of Pakistan for anaesthesia training in UK. Dr Anis-Ur-Rehman Khan also obtained FFARCS while Dr Attar completed his DA from UK. Dr Attar joined Jinnah Hospital Karachi in 1953 and established the Department of Anaesthesia. He also started lectures and other academic activities there and trained many well-known anaesthetists of that time.

- Dr Syed Viqar Hussain Zaidi, a graduate of King George Medical College Lucknow and DA from the UK, joined the Liaqat National Hospital in Karachi in 1967 and became the Head of the Department of Anaesthesia. He also had a side career in sports medicine and was appointed an "International Judge" at the Seoul Olympics for drugs testing due to his anaesthesia and sports medicine background.

- Dr Jamil Ahmed, a graduate of KEMC, joined Lady Reading Hospital (LRH) in 1964 after obtaining DA from UK. Later he became the first Professor of Anaesthesia in 1972, having obtained his FFARCS.

No data or facts from the province of Baluchistan from 1947 to 1972 are available. However, after establishment of Bolan Medical College (BMC) Baluchistan in 1972, Dr Niaz Nasir was appointed as the Head of the Department of Anaesthesia there.

The College of Physicians & Surgeons of Pakistan (CPSP) was established in 1962 through an ordinance of the Federal Government of Pakistan with untiring efforts of the senior physicians of the time at the national level. In

the beginning, a two-year training program of MCPS (initially called DCPS) was started. First MCPS examination was held in 1964. Later, training for FCPS was also initiated (similar to that of FFARCS) and 1st FCPS Anaesthesia in Pakistan was awarded to Dr Faiz-Ur-Rehman in 1968.

Identifying the need to promote the discipline of Anaesthesia in Pakistan, PAA (Pakistan Association of Anaesthesiologists) was formed in 1968 by Dr M Salim. Pakistan Society of Anaesthesiologists (PSA) was founded in Karachi in 1971 and the previously formed PAA was merged into the newly formed PSA. Dr Habib-ul-Haq Siddiqui was the 1st President of PSA and Dr Muneer and Dr Attar were the founding members.

1973-1989: Balanced Anaesthesia

Rapid progress in development of the specialty took place during this era as several highly qualified anaesthetists trained in the UK and the USA had chosen to return to Pakistan. This was a major turning point for the specialty of Anaesthesia in Pakistan. These returning anaesthetists included:

- Dr Mohammad MunirUd-din, Jinnah Postgraduate Medical Centre (JPMC)
- Dr Jhuman Das Manjhani (JPMC)
- Dr S Tipu Sultan, CHK & Dow Medical College (DMC)
- Dr Akhtar Waheed Khan, Liaqat National Hospital (LNH)
- Dr S Ali Raza Zaidi (Baqai hospital)
- Dr Rehana Kamal, Aga Khan University (AKUH)
- Dr Fauzia Anis Khan (AKUH)
- Dr Nasir Khan Jakhrani (JPMC)
- Dr Ursula Chohan (AKUH)
- Dr Akhtar Aziz Khan (LNH)
- Dr Sajida Ahmed**,** Karachi Adventist hospital (KAH)
- Dr Mehdi Hasan Mumtaz, Nishtar Medical College, Multan
- Dr SU Kaul (KEMC)
- Dr Noman Ahmed, Sheikh Zaid hospital
- Dr Khursheed Alam, Lady Reading hospital (LRH)
- Dr Rahat Sahabzadah, First American Board in Pakistan (LRH)
- Dr Akbar Said Jan (LRH)
- Brig Mohammad Salim

- Brig Zafar Ahmed
- Brig Zafar Ali

These people made a huge impact on development and delivery of clinical services, education, and training in the discipline of Anaesthesia in Pakistan. During this era, increasing number of trained anaesthetists started "balanced anaesthesia" for a variety of surgical procedures in major teaching hospitals of Pakistan. They introduced pre-operative anaesthesia assessment and started looking after Intensive care units (ICUs). The first 5 bedded ICU was started in 1981 at Nishtar Medical College Hospital, Multan by Dr Mehdi Hasan Mumtaz, followed by a 4 bedded ICU at Mayo Hospital Lahore and a 5 bedded ICU at AKUH by Dr Rehana Kamal in Karachi in 1984.

Another important development at this time was the introduction of inhalational anaesthetic agent halothane (replacing ether and trichlorethylene) as well as muscle relaxants in clinical practice. The muscle relaxants suxamethnium, tubocurarine, gallamine and pancuronium were started being used and the patients were ventilated using a minute-volume divider the "Manley Ventilator." The airway was managed with red rubber ETTs. A large number of second hand refurbished anaesthesia machines and ventilators from abroad arrived at this stage.

Intravenous induction agents such as thiopentone, and muscle relaxants and analgesics were administered using reusable metal needles needing sterilisation after each use. This problem was overcome with the introduction of disposable intravenous cannulae in late 1970's in CHK and in early 1980s in the majority of big teaching hospitals in Pakistan.

Ketamine had no marketing licence in Pakistan until early 1980s. Pentazocine and buprenorphine were the main analgesics used in majority of procedures. Pethidine was also used during major surgery while morphine was erratically available in some prime teaching hospitals. Spinal anaesthesia continued to be used for lower limb and gynaecological surgery using the then new local anaesthetic, bupivacaine. Epidural analgesia was also introduced in the late 1980s despite resistance from obstetricians.

The first oxygen saturation monitor became available in 1985, being introduced in Karachi and used during the first kidney transplant at SIUT

(Sindh Institute of Urology and Transplantation) and at AKUH. No evidence of temperature monitoring was found in any area of Pakistan but the first use of the capnograph was at AKUH in Karachi in 1989.

Significant advances in surgery occurred with the introduction of safe balanced anaesthesia administered by well-trained anaesthetists with vigilant monitoring of all systems. In addition to clinical service, anaesthesia training programs and academic activities were also established widely across the country during this time. PSA Karachi also started organising regular annual conferences from 1983 onwards. PSA became a member of WFSA in 1988. The evolution of clinical research in Pakistan passed through a difficult phase. The first clinical trial was conducted in 1986-87 by Dr Fauzia Khan as a principal investigator (PI) and published in "Anaesthesia" in 1989.

1990 – 2000: Smart Anaesthesia

In this era, well-trained anaesthetists took over the leadership of operating theatres leading to advancement in equipment and monitoring of patients during anaesthesia. The concept of the use of disposables also came into practice. All patients started to be monitored routinely for many physiological functions. Newer and safer anaesthetic agents started being used in anaesthesia practice. Atracurium replaced the earlier longer acting muscle relaxants, and halothane was replaced by enflurane and isoflurane. Disposable ETTs and newer breathing circuits were also introduced along with different and new modes of ventilation. Epidurals and combined spinal-epidurals were introduced into clinical practice. Essential intraoperative monitoring (ECG, NIBP, $EtCO_2$, SPO_2) for all major surgical surgical procedures became a routine.

Anaesthesia was now becoming a choice specialty for many new doctors. All teaching hospitals (AKUH, DMC, JPMC, LNH, NMC, PIMS) of big cities started postgraduate training for both MCPS & FCPS. By the end of this era, almost all teaching hospitals of Pakistan had locally trained anaesthetists (MCPS & FCPS). The concept of pre-anaesthesia clinic was introduced, and the first such clinic launched at AKUH in 1994 by Dr. Rehana Kamal.

Anaesthetists were also responsible for running high dependency (HDU) and intensive care (ICU) units and running resuscitation, and trauma and emergency services in all big teaching hospitals.

The first public sector SICU (Surgical Intensive Care Unit) was founded in Karachi at CHK under the leadership of Dr Tipu Sultan. A round the clock labour pain service was started at the AKUH under the leadership of Dr Ursula Chohan in 1999.

Journal clubs, morbidity and mortality meetings, and anaesthesia tutorials were started in all teaching hospitals. Postgraduate courses at the national level were started being held regularly for FCPS & MCPS examination preparation.

Anaesthesia in Pakistan is now recognised at Regional and the International level. The South Asian Confederation of Anaesthetist (SACA) now named as SAARC was founded in 1991 with Pakistan as a founding member. The first issue of the journal 'Anaesthesia, Pain & Intensive Care' was published by Col. Tariq Hayat Khan from Armed forces institute of urology (AFIU) Rawalpindi as 'Anaesthesia News'. Now this is the only journal under the banner of PSA.

Another achievement in this era was the introduction of critical incident monitoring by Dr. Fauzia Khan at Aga Khan University in 1996. This is in practice in several institutions for outcomes monitoring.

2000 - till today: Precision Anaesthesia

The era of "Precision Anaesthesia" at the turn of the century started with a rapid development in anaesthesia according to increasing demands of complex and advanced surgical procedures. Total intravenous Anaesthesia (TIVA), advanced airway adjuncts, fibreoptics, anaesthesia workstations, Bispectral Index monitors, regional anaesthesia, patient-controlled analgesia, combined regional and general anaesthesia techniques are being used in a variety of surgical procedures. Several newer agents such as fentanyl, tramadol, bupivacaine and ropivacaine were also launched in all big cities of Pakistan.

Peripheral plexus block under ultrasound guidance for anaesthesia and analgesia were started becoming used in the last decade across the country. The advancement in general and regional anaesthesia techniques, anaesthesia monitoring and equipment with properly trained and highly qualified anaesthetists are the main driving force for performing complicated surgical procedures in almost all surgical subspecialties. In addition, rapid progress in delivering anaesthesia outside the operating room eg radiology, ECT and MAC services for ERCP, brachytherapy etc has now been established. The practice of audits and clinical governance are also now part of practice.

Anaesthetists in Pakistan were at the forefront during COVID-19 pandemic. The skills resuscitation, airway management, and the reflexes to deal with the ever-changing human physiology have placed anaesthetists in a unique position to deal with critically ill patients as happened during the Covid-19 pandemic. Managing critically ill patients in ER, high dependency unit and ICU, and managing organ failure has rightly earned high plaudits for anaesthetists, something much denied in the past.

Future Direction:

This brief history highlights the successes and failures of discipline of the development of anaesthesia Pakistan. There are more successes failures in the last four decades and the development continues in this emerging discipline. Worldwide, the demand of anaesthetists is expected to increase due to the high prevalence of ageing population, need of complex surgery, and management of pain, critical care and trauma, and Pakistan will be no exception.

The awareness level of common Pakistani citizen about anaesthesia and anaesthetists has risen significantly in last two decades and so has the demand. Surgeons have also become dependent on anaesthetists for the routine as well as the complex procedures.

The focus for future must remain on patient safety, quality improvement and collaboration to ensure the delivery of safe care before, during, and after surgery as a *perioperative* physician and for future developments. Globally, it has been recognized that access to safe anaesthesia for essential surgical care is a basic human right and should be available to all patients.

Considering the demand, “anaesthesia” is one of the most futuristic specialities.

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Academisation of Anaesthesia Departments in the Netherlands: A British heritage

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Academisation is the process in university teaching hospital anaesthesia departments leading to the instalment of a Professor as Head of an independent Department. In this paper this process in Dutch university teaching hospitals is described starting after the World War II (WW2) up to 1972.

This paper is based on the content of the special edition of the Dutch Anaesthesiology Society's Journal "De Anesthesioloog", on the occasion of its 75th anniversary [1]. After two books with historical content commemorating 40th and 50th anniversaries of the Dutch Anaesthesia Society, the history group decided to explore the academisation in the University Teaching Hospitals in the Netherlands.

How did it come about in the different institutions? The Universities of Rotterdam (Erasmus) and Maastricht were not included as they were founded later with anaesthetic departments from the beginning. The Board of the Society, viewing books to be antique, provided funds for a Supplement to the Society's Journal. In his introduction, the medical historian Prof em M J van Lieburg points out that in the Netherlands the prescription of internal medicines was limited to academic physicians. Only after 1876, when the Higher Education Act was passed in the Parliament could academisation exist, all medical practice being limited to university trained physicians. Formerly barber surgeons needed to ask the *medicinae doctores* to administer anaesthetics, a turning of the tables from the previous situation when the learned doctor asked the barber surgeon to perform the operations.

Before WW2 there were not more than five medical doctors solely practicing the provision of anaesthesia in the Netherlands (*narcologen*). Surgery and obstetrics were under the influence of the German Austrian system of a know-all chief running the department. This implied that the surgeons were

responsible for the complete care of the patient, before, during and after the operation. Recommendations by consultant paediatricians and internal medicine physicians were optional.

The majority of anaesthetics in the teaching hospitals were administered by the most junior surgical resident, who passed the job on as quickly as he could. In the country and town hospitals the anaesthetics were administered by a nurse, many of whom were quite expert with the Julliard mask and ether dropper bottle. The nurse kept the patient asleep observing for any signs of danger, all under the surgeon's supervision [2]. Patients undergoing difficult operations, such as for pulmonary tuberculosis, fared better if cared for by a doctor anaesthetist with experience in preoperative care. As there was no renumeration for anaesthetics by the health insurance companies the surgeon paid the doctor anaesthetist out of his own reimbursement. The theory of anaesthesia and its practical applications were described in Theodoor Hammes' (1874-1951) "*Leerboek der Narcose*" (Anaesthesia Manual, 1906) [3]. It was the first such book meant for readership of medical doctors; it was translated into French and had three editions, the last in 1919.

After WW2 Dutch surgeons realised that the medical and surgical care witnessed in the Allies' field hospitals was superior to what they had been used to, even taking into account the austerity during the war. It became clear that the introduction of penicillin and the presence of physician anaesthetists in the operating theatres made a huge difference in the outcomes of trauma surgery.

The Dutch government financially supported visits by senior physicians and surgeons to Britain and the United States. They returned with clear recommendations, one of which was to commence the training of doctors in anaesthesia. Professor L Eerland (1897-1977) of Groningen had already pointed out in 1939 that thoracic surgery demanded professional anaesthetists and that they be properly trained. All developments were however slowed due to the outbreak of the war. His trainee I Boerema (1902-1980), appointed head of the surgical department in **Amsterdam** in 1946, started the "Training School for Professional Anaesthetists". The specialist responsible for the training had been found by his predecessor Professor W Noordenbos (1875-1954). He had met Doreen Cranch, DA (1915-2011) at a Royal Society meeting in London, and on learning of her

intended move to Amsterdam, where her husband was director of a shipping company, invited her to come and practice in his department. Boerema was in Boston at the time, he requested Noordenbos not to let her go and when back saw to her salaried appointment.

The first trainees commenced on January 1st 1947, they had been general practitioners before the war and shared one resident's income in the first years. Doreen Vermeulen-Cranch was awarded the Fellowship of the Faculty of Anaesthetists of the Royal College of Surgeons in 1948. On the 18th of December 1951 she was appointed *Privaatdocent* (Lecturer), the first step to academisation. Her public lecture on acceptance of the position was titled *Ontwikkeling van de anesthesie tot heil van de patient* (Patients wellbeing by anaesthesia development). Her first trainees did doctorate research on the monitoring during thoracic operations. Boerema acted as promotor, only after 1958 could she be promotor herself.

The University of Amsterdam, including the Wilhelmina Gasthuis teaching hospital, were municipal institutions until 1960, which meant that all appointments and expenditures had to be legitimised by the municipal council. Boerema wrote countless requests for more staff and anaesthetic equipment until the Department received its own budget in 1956. On July 1st, 1958 Doreen Vermeulen - Cranch was appointed extraordinary Professor in the Medical Faculty. Extraordinary, as it was not fulltime (i e 10, not 11 half days as she wanted Wednesday afternoon off to be available for her children; children in the Netherlands have school on Wednesdays only in the mornings). At the time she did not have a doctorate and had authored four papers. Her public lecture for the occasion was titled *In somno securitas*. Her appointment made her the first Professor of Anaesthesia on the European continent and the first female Professor of Anaesthesia worldwide.

In **Groningen** in the later 1930s L D Eerland had realised that the person administering anaesthesia was more important than the agent, a contrast which had dominated anaesthetic discourse until then. The Board of the "General, Provincial, Town and Academic Hospital" agreed to commence a two year training for anaesthetists in January 1947. C Ritsema van Eck (1905-1976) a former surgeon, was appointed chief. He was refused permission to train in Britain in 1946 as there were British anaesthetists in the country with whom he could train. After spending three months with F

W Roberts (1911-2005) in Utrecht he was given a certificate declaring him "able to administer anaesthetics in any hospital". On September 1st, 1947 he was appointed Lecturer. In 1948, he did a four months fellowship in the Nuffield Department at Oxford. Remarkable compared to modern conditions were the apparatus that the Groningen anaesthesia department developed in their own laboratory together with the Professor of Physiologic Chemistry R Brinkman (1894-1984). The "Haemoxymeter" measured oxygen content in blood samples, the "Carbovisor" carbon dioxide in expired air, the "Cyclops" oximetry on the forehead while the "Cirrestor" was the first heart-lung machine to be used on the Continent on May 8th, 1957.

A major contributing factor to this ground breaking work was the excellent cooperation between the surgeons, laboratory specialists and anaesthetists. Research using the above apparatus led to international publications and several dissertations [4]. Ritsema travelled on a six month Fellowship to the USA in 1956 to further his expertise in cardioanaesthesia. Academisation was complete in Groningen when he was appointed Professor in 1960. He is also known as one of the founders of the WFSA.

In **Leiden** the professor of Surgery did not have a personal interest in thoracic surgery which led to lengthy faculty discussions and controversy on how to organise a "Heart-Lung" unit. Prof J H Zaaijer's (1876-1932) overpressure nitrous oxide apparatus had become obsolete with the introduction of endotracheal tubes and respiratory control after WW2. Allowing a second Professor to the Surgical Department was a novum for the Netherlands, where a lone patriarch was the norm. When a thoracic surgeon was finally appointed in December 1950, realisation came that anaesthetists would be needed as well. When plans were ready in 1951 it turned out that the Surgical department already had an anaesthetist, the South African P L Leeuwenburg, who had been trained in Britain during the war. When he decided to return home H Boeré (1905-1999), one of Doreen Cranch's first trainees was appointed as the anaesthetist. He had been attaché to the 2nd Rhine Army of the British Military Mission in Germany where his interest in modern anaesthesia had developed. He did doctorate research with Brinkman in Groningen, leading to his dissertation "The continuous observation of oxygenation of the blood during anaesthesia and its meaning" in July 1951. In the same year he was appointed Head of the Anaesthesia sub-department within the Derpartment of Surgery. Appointment as Lecturer

followed in 1954. Boeré's years in Leiden were a continuous struggle for funds and staff, with Eastern European refugees willing to accept the relatively low salary. Regardless some research continued to be done mainly on monitoring techniques such as measurement of oxygenation, plethysmography and pneumotachography (for the measurement of the effects of new analgesics on respiration). J. Spierdijk (1927-2006) was appointed a full Professor on Boeré's retirement in 1971,

The situation in **Utrecht** was dominated by the Professor of Surgery J Nuboer (1900-1979), an old fashioned despot of the Vienna school of Surgery.

Anecdote:

> *When Doreen Cranch made a round of visits to the other university hospitals in the Netherlands shortly after her appointment in Amsterdam Nuboer told her "we don't need anaesthetists here". Some time later, on a rainy Sunday morning, the doorbell of her upstairs apartment in Amsterdam rang. Her husband had a look in the mirror above the entrance exclaimed "it's an elderly gentleman". After the door was opened with the cord along the staircase railing, the gentleman climbing the stairs turned out to be professor Nuboer from Utrecht. After politely requesting permission to enter he admitted having problems with the anaesthetics. Several patients, although nicely pink and breathing well, had had convulsions. Doreen agreed to come and have look, her suspicions of hypercapnia soon confirmed when she found the valves of a modified McKesson machine to be missing. Whereupon she said "Well, maybe you do need anaesthetists…."*

This led to an advertisement in the October 1946 *Anaesthesia* to which F W Roberts (1911-2005) responded. His diary has been transcribed and the relevant part kindly given to our society by his son. The diary also gives some insight in goings on in London. Francis William Roberts trained in the Middlesex hospital and became a partner in the "Mayfair Gas Company" with R R Macintosh and W S McConnell. They would not allow him to return in the partnership if he left for Utrecht, nor were they willing to pay him his share. Roberts was quite disgruntled when he learned that later they

had sold his share to a Dr Roche). He stayed for two years in Utrecht, in a purely hospital, non-university position, training several colleagues, not least Ritsema van Eck from Groningen. Nuboer's increasingly unpleasant behaviour was the main reason for his move to South Africa.

The Scottish anaesthetist James Johnston stayed too short in Utrecht to leave traceable biographical details behind. A number of Eastern European physicians with anaesthetic experience filled the gaps until C Pearce (1921-2001) was appointed consultant in the surgical department in 1953 and Lecturer in 1957.

The Utrecht hospital was built in the Central European pavilion style; every department a kingdom, with each their own arrangements for anaesthetic care.. When Pearce left for the Amsterdam Free University Teaching hospital in 1967 the situation was a disorganised mess. Training qualification was revoked. The National Medical Registry board demanded a central anaesthesia department which prof Nuboer obstructed. Only after his retirement in 1970 could a central department with a full professor, B Smalhout (1927 - 2015), be instituted.

Nijmegen had a Catholic Teaching Hospital of sorts with the surgical department of the large city Canisius Hospital serving as temporary location while the St Radboud hospital was being built. The medical faculty had commenced teaching in 1951, so that clinical workspace was needed from 1954 onwards. The faculty, realising the importance of a central anaesthetic department, could only find one candidate who complied with their requirements: Catholic and possessing a doctorate degree. J Crul (1922-2006) had trained in Groningen from 1951 to 1953, achieved his doctorate on ganglioplegics research and had practical experience in Roermond. Being the only feasible candidate gave Crul good bargaining opportunities. He got his department, with say over all operating sites. After his appointment as lecturer in 1957 he was able to attract scientifically minded staff leading to numerous publications mainly concerning organisational matters. The resident training program was popular, with Crul delegating tasks to senior staff members. His appointment as full professor in 1967 was the product of years of dedicated academic endeavour.

In **Amsterdam** there were two universities, as the conservative protestants had founded their **Free University** with humanities faculties in 1905. During the interbellum the need was felt to expand with a medical faculty, illustrating the religious division in society in the middle of the 20th century, with protestants mainly North of the Rhine, and catholics to the South. No anaesthetist's room was planned in the new theatre complex, although the nurse did have one. In 1965 D A Keuskamp (1915-1992) was appointed as anaesthetist, in a non academic position. It illustrates the view held by the medical faculty of anaesthesia being supportive of non-academic form of manual labour.

Keuskamp had trained with Doreen Cranch, doing doctorate research on air cooling in cardiac surgery (1960). A very innovative inventor, he built the Amsterdam Infant Ventilator in his home shop, later taken into commercial production by the Loosco company. Specific for this machine was "Keuskamp's thumb" a toroid controlled expiratory valve for the Jackson Rees circuit. Keuskamp was to be appointed Lecturer, while he wanted a Professorship; along with the lack of funds for equipment, reason for him to leave in 1968 when the new faculty in Rotterdam offered him the position he aspired.

Foreign locums were hired to allow surgery to proceed, while C Pearce (1921-2001) in Utrecht was approached for the Lecturer position. Cecil Pearce studied in St Bartholomews, London from 1939 to 1946, with a break during the war. He trained in anaesthetics at the Moorgate General Hospital, obtaining DA in 1952 and FFARCS in 1954. He had come to the Netherlands as successor to Roberts at Utrecht who also left due to the difficult working conditions. He was appointed Professor in 1970 when the conditions became better in the Faculty. The title of his inaugural lecture was "Homeostasis: past, present and future".

The general impression of the history of the Dutch teaching hospital departments is that their insight improved by the demands made by the emerging thoracic surgery for the provision of trained professional anaesthetists and well organised anaesthesia departments. The individual appointees then made academisation possible by their research activities, beside training residents and teaching medical students. In some institutions (Groningen, Amsterdam) surgeons greatly enhanced the development of

anaesthesia, in others they obstructed it (Utrecht, Amsterdam Free University). Groningen being an example of how friendly, non-competitive scientific cooperation led to worldwide recognised results and Utrecht staying in 19th century conditions until the Professor of Surgery finally retired.

The gradual emergence of our specialty as an academic specialty from 1945 to 1970 is illustrated in the multi-author Supplement edition of the journal with added emphasis on training, and the development of subspecialties of Pain Management and Intensive Care. A special chapter summarises the highlights of the oral history project.

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History and Evolution of Anaesthesia Education and Training in a Low to Middle Income Country

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Background

Exploring the history of the development and progress of educational processes and systems is crucial to study the process of change over time, the reasons behind the changes and the overall effect of these changes. It helps to understand how the present education systems were shaped by past events, provides a foundation to plan for future educational development and helps in creating smoother paths towards improvement and avoiding mistakes [1]. Additionally, it gives an indication as to where we are headed and provides us the opportunity to compare our progress with others and to learn and improve from our own past experiences [1,2].

Some baseline information about Pakistan is provided here to give a background on the general status of education and healthcare in the country. Pakistan is a densely populated, low-to-middle income country (LMIC), which gained independence from British rule in August 1947. The Gross Domestic Product per capita in Pakistan was last recorded at US$1535.72 in 2022, placing it 129th in world ranking and equivalent to 12 percent of the world's average [3]. The provincial and federal budget for 2022, in terms of health to GDP ratio, was 1.4% and on education 1.7% in the fiscal year 2022-23 [4]. The country's estimated literacy rate is 58.9 per cent [5]. In 2021, computer literacy was found to be 36.1% among males and 32.6% among females, although it is much higher when only the youth are considered [6].

The country is divided into four provinces with four separate provincial assemblies formulated by provincial elections. The four provinces have different spoken languages and have remarkably different cultures. The population consists of many different ethnic groups and up to 64% of the population resides in rural areas [5]. Each province has its own education ministry that oversees education related matters, including approval of

curricula, especially at the school level. The standard of basic education differs markedly between public and private schools and in rural and urban parts of the provinces. This variability in educational standards becomes more evident at the university level and is evident at the time of admissions. The students from public and rural schools who manage to get into urban universities often have to struggle to keep abreast with the standards and pace of learning.

Postgraduate medical education in anaesthesia in countries such as the USA has evolved over the years from an apprenticeship model to structured training overseen and monitored by specialty college [2]. The process has evolved at varying pace in different parts of the world. We present here a brief history and evolution of postgraduate anaesthesia education and training in Pakistan. The sources of information for the content presented in this article include in-depth literature review, portal of the College of Physicians and Surgeons, Pakistan (CPSP) and information shared by senior colleagues from public and private institutions during informal discussions.

Anaesthesia Training in the Early Years: 1947 to 1962

Very scarce data is available about the history of anaesthesia and its training in the early years of the creation of Pakistan as an independent state. It appears that anaesthesia remained a neglected specialty during the initial years and its growth as a specialty was slow and gradual. Moreover, establishment of anaesthesia services progressed at varying pace in the four provinces of the country. Until 1960, there was no formal anaesthesiology training program and there was a general perception among medical community that very little training was needed to qualify as an anaesthetist. The training of the earliest anaesthetists of Pakistan took place mainly in the United Kingdom (UK) during the years 1948 to mid 1950s [7]. These pioneers established anaesthesia departments in their respective institutions and were the trailblazers of postgraduate anaesthesia education in the country.

One of the earliest anaesthetists of Karachi, Dr Abdur Rehman Umar Attar went to UK for anaesthesia training. After attaining his diploma in anaesthetics (DA), he returned to Karachi and started academic activities at a tertiary care teaching hospital in 1953 [7]. He went on to train many

renowned anaesthetists of the time. Around the same time, Professor Rustam Ali Nabi also pursued DA training in UK and started anaesthetic practice and training in Lahore on his return. In these initial years, training took place through an apprenticeship model. The first diploma programme was started by Dr. Nabi in 1960 at the University of Punjab and the first diploma examination was held in 1962 [7]. Dr. Nabi then proceeded back to UK for fellowship training and returned to work and teach in Lahore after obtaining his Fellowship of the Faculty of Anaesthetists of the Royal College of Surgeons (FFARCS).

National College for Postgraduate Medical Education: 1962 Onwards

Identifying the need for structured postgraduate training at the national level, the College of Physicians and Surgeons of Pakistan (CPSP) was established in 1962 through an ordinance of the Federal Government of Pakistan with untiring efforts of the senior physicians of the time [8]. The college initially established postgraduate training in the core specialties of medicine, surgery, paediatrics, gynaecology and obstetrics. Within the next one year, work was started on training in other specialties, including anaesthesia. Presently CPSP oversees residency training in 46 specialties and sub-specialty training is offered in 34 disciplines [8].

Anaesthesia training was started by CPSP as a two-year programme resulting in the award of the Diploma of the College of Physicians and Surgeons (DCPS). It was soon renamed as Membership of the College of Physicians and Surgeons (MCPS). The eligibility criterion to sit the examination was the experience of anaesthetic management of a minimum of 200 cases approved by the supervising faculty. Nine candidates appeared in the first examination held by CPSP, two of whom were successful.

MCPS to FCPS

After the successful start of MCPS, training for Fellowship of CPSP, termed FCPS, was planned and implemented due to the efforts of senior anaesthetists and academicians at CPSP. The first FCPS anaesthesia candidates were inducted in the early 1970s. The curriculum designed for FCPS was similar to the FFARCS curriculum. FCPS final examinations consisted of a true-false multiple-choice question paper, examination of a

long case and an oral examination (viva). Due to scarcity of anaesthetic examiners, physicians and surgeons were invited as examiners for the first examinations.

Faculty of Anaesthetists

Faculty of Anaesthetists of CPSP was established in 1992 and its first Dean was appointed by the College President. The faculty focused diligently on improving and streamlining the curriculum of training and assessment methods. Anaesthesia gradually became a choice specialty for many new doctors and most teaching hospitals started structured postgraduate training for both MCPS and FCPS. By the 1990s, trained anaesthetists were available in most of the teaching hospitals of Pakistan. A prominent change seen in this era, compared to the earlier group of UK trained specialists, was that the majority of anaesthetists were locally qualified specialists with robust structured training of 2-4 years (MCPS and FCPS).

Evolution of Training and its Present Structure

Over the years, the Faculty of Anaesthetists at CPSP has made great efforts to improve the quality of anaesthetic training. There are strict criteria for accreditation of training institutions. Furthermore, stringent criteria have been defined for appointment of training supervisors and CPSP examiners. Training supervisors are required to attend a series of educational workshops conducted by experienced educationists at CPSP, before they can apply for supervisorship. These workshops encompass skills required for effective supervision, including communication skills, curriculum development and assessment, research methods and supervisory skills. The supervisors are also required to submit 50 single-best multiple-choice questions (MCQ) to the question bank of CPSP.

It is mandatory for the trainee to pass part I FCPS examination in anaesthesia, consisting of MCQ papers to assess relevant knowledge in basic sciences, before he/she can get registered with CPSP as a trainee and start his/her training at a registered institution. In the first two years of training, it is mandatory for all trainees to attend four workshops / courses conducted by CPSP. These include:

1. Computer skills (including Microsoft Office)

2. Research methodology and dissertation writing
3. Communication skills
4. Basic life support (BLS) and advance cardiac life support (ACLS)

In initial years, the trainees needed to pass two examinations to attain the FCPS qualification, part I and part II. Because of the disparity in the standard of basic education obtained by the trainees joining from different regions of the country, it was important to ensure that the trainees had achieved a minimum standard of baseline knowledge and skills required for effective training in anaesthetics. Considering this, in early 2000s, the Intermediate Module (IMM) was introduced. It comprises of formal examination after the first two years of FCPS training following defined rotations and curriculum. The aims of the IMM examination are to ensure uniform standards of training, assess the progress of the trainee, and undertake timely corrective measures where required.

Minimum number of cases has to be conducted in each anaesthetic sub-specialty and the number of practical procedures required to be performed in each year of training have been defined in the curriculum. Electronic monitoring of training is carried out through e-logbook which was introduced in 2011. The supervising faculty is responsible for ensuring that the required training is being provided and logged in a timely manner and is required to check and approve the logged cases and procedures on a regular basis. This is monitored by CPSP, and quarterly online feedback is submitted by each training supervisor.

In the third and fourth years of training, the trainee completes the rotations defined for FCPS Part II. Additionally, the trainee is expected to pass the intermediate module examination within 18 months of completing the IMM rotations. This examination is conducted twice a year and consists of two papers of 100 single-best answer MCQs each, and task-oriented assessment of clinical skills (TOACS), which is similar to objective structured clinical examination (OSCE) and comprises of 14-15 stations of 6 minutes each.

Another mandatory requirement during the four-year anaesthesia training is completion of a research project and submitting a detailed dissertation to CPSP or publication of two research papers in peer-reviewed journals. The training supervisor is responsible for supervising the research conducted by

the trainee. Timeline for completion of each step of the research project/s is clearly defined, including writing of the research protocol, approval of the protocol by institutional review board and CPSP research cell, data collection and analysis, write-up and compilation of the dissertation document and its submission and approval by CPSP.

The trainee is eligible to appear in the part II of the examination after completing four years of training with all mandatory rotations, and approval of the dissertation by the research cell of CPSP or publication of two papers. The components of the part II (final) FCPS examination include MCQ papers, TOACS, table viva and long cases. The road map for FCPS training defined by CPSP [8] is provided in Table 1.

Table 1: Road Map for postgraduate anaesthesia training for Fellowship of College of Physicians & Surgeons Pakistan

1	Passing *FCPS Part I
2	Induction into a training program
3	Assigning of supervisor
4	Registration with #CPSP
5	Clinical training with rotations specified for Intermediate Module (two years)
6	Research project initiation with timelines for each step from protocol writing to dissertation/publication of two papers
7	E-logging of cases and procedures and supervisor's approval
8	Formative workplace-based assessments
9	Intermediate Module examinations
10	Rotations specified for FCPS Part II (two years)
11	Submission and approval of dissertation/ publication of two papers (fourth year)
12	FCPS Part II examinations (on successful completion of 4-years of training)

*FCPS: Fellow of College of Physicians & Surgeons Pakistan
#CPSP: College of Physicians & Surgeons Pakistan

In recent years, residency training has been reorganized based on the competencies and outcomes to be achieved. Competency-based structured residency training curricula have been developed for perioperative patient care, critical care, trauma and pain medicine. Formative and summative workplace-based assessments have been introduced, including direct observation of procedural skills (DOPS), mini clinical evaluation exercise (mini-CEX) and case-based discussions. Structured forms have been introduced for this purpose and efforts are being made to implement these assessment strategies in all training centers.

Sub-specialty Training

Over the last two decades, structured training has been developed in three anaesthesia sub-specialties:

- Cardio-thoracic anaesthesia
- Intensive care medicine
- Pain medicine

CPSP has formulated designated faculties for these sub-specialties, who have designed comprehensive curricula for teaching, learning and assessments of the trainees.

Thus, Anaesthesia training in Pakistan has evolved considerably since the birth of the country in 1947. At the beginning, there were no qualified anaesthetists in the country. A handful of anaesthetists, mainly trained from UK, played a major role in training the early day specialists. Since the establishment of CPSP till 2022, more than 1250 physicians have successfully attained FCPS and around 1500 have completed MCPS. Furthermore, there are more than 230 registered training supervisors and over 100 accredited training centers. The current challenges to ensure high quality standardized training at all accredited training centers across the country are to ensure uniform standards of training throughout the country, to implement standardized induction criteria for trainees at national level and to implement workplace-based formative and summative assessment throughout training.

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William Ernest Henley and his 'In Hospital' Poems

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William Ernest Henley (WEH) (23 August 1849 – 11 July 1903), was a sufficiently well-known Victorian poet, author and critic to have his bust sculpted by Auguste Rodin and displayed in the crypt of St Paul's Cathedral, London. Today, as the poet who penned 'the unconquerable soul', he is largely forgotten except as the author of *Invictus* which is the literary insignia of the *Invictus Games* for disabled servicemen.

Henley's life was blighted from the start due to infection from tuberculosis. His left leg was amputated below the knee aged 16 years and although he passed the entrance examinations for Oxford, there was no money for education. His father died when he was 19, and to support the family he sought work as a freelance writer and journalist in London, where he became very successful. He would subsequently edit periodicals, support the young Yeats by publishing his work and become a friend of Whistler, Rodin and Barrie. Wendy in Barrie's Peter Pan was modelled on Henley's daughter who died as an infant from meningitis. Later in his life he would write the (still) definitive biography of Robbie Burns.

Around 1870, in his early twenties, Henley developed tuberculosis in his right leg. The first doctors he approached had little to offer, then he learnt of Lister in Edinburgh (before Lister had published his famous papers on anti-sepsis). Approaching Lister, he persuaded him to take him on as a patient and entered Edinburgh Royal Infirmary in Drummond Street in August 1873. After repeat anaesthesia, surgery, and immobilisation, he was discharged with his right leg intact in April 1875. Henley funded himself during this time by continuing to work, edit and review. It was here that he met R. L. Stevenson, and became the model for Long John Silver. Stevenson said 'It was the sight of your maimed strength and masterfulness that begot "John Silver"'.

Prior to the nineteenth century (the Victorian age), prose did not really feature as a medium for serious literature; almost everything regarded as valuable was published in verse. However, during Henley's lifetime, there

was a fundamental change from verse to prose; both becoming respectable. 'Victorian Realism' entered literature contributing real stories about real people, and the novel became a social statement through fictitious narrative. Typical authors were:

Charles Dickens	(1812-1870)
Charlotte Bronte	(1816-1855)
George Eliot	(1819-1880)
Mrs Gaskell	(1810-1865)
Thomas Hardy	(1840-1928)

At that time, in the second half of the nineteenth century Britain was at the height of her powers. She had the greatest GNP in the world, 50% of world's industrial capacity, produced over 50% of the world's coal and over 50% of the world's iron. These authors were often criticising the consequences of this industrial revolution on the workplace conditions and social change experienced by the working population.

Henley's contribution was to try to extend the Victorian realism of prose into poetry and he did this by using his time in Edinburgh Royal Infirmary as the source of what are now known as his 'Hospital Verses'. In very basic terms, poetry is presented in three ways:

Traditional:	Definite beat and end rhyming sounds
Blank Verse:	Definite beat but syllabic rhyming
Free Verse:	No definite beat, no rhyming (introduced by the French as *verse libre*)

The advantage of free verse is that it allows the lines, with their varying length and irregular punctuation to create drama and sudden events. Henley's 'Hospital Poems' are now accepted to be 'the first resolute attempt in English to use ugliness, meanness, and pain as subjects in poetry' (see Pinto in bibliography at the end). Three of the verses, 'Before', 'Operation' and 'After' are, as far as is known to the author, the only accounts of pre-operative preparation, induction and emergence from open drop chloroform anaesthesia in poetic form. The verses were published after he had left the hospital. The first tranche called 'Hospital Outlines', contained eighteen sonnets printed in the *Cornhill Magazine* in 1875. The second, consisting of

thirteen free verses was ‘Hospital Sketches’, contributed to a charity book, *Voluntaries for an East London Hospital*, in 1887. The third (and best known source) was a condensation of the 1875 and 1887 texts totalling twenty-eight poems published as ‘In Hospital: Rhymes and Rhythms’ in, *A Book of Verses* in 1888. These poems were subject to significant criticism by such luminaries as Oscar Wilde and George Bernard Shaw. As well as providing pen-portraits of surgeons, nurses and visitors, at times the poems are quite graphic, describing such things as induction of and emergence from anaesthesia, unsuccessful suicide, head injuries, waking up from surgery and the loneliness of the hospital night.

The following selection of seven poems was presented the History of Anaesthesia Society Meeting in Llandudno in 2023:

- Staff nurse; old style. (Sonnet)
- Nocturn. (Blank verse)
- Casualty. (Free verse)
- Suicide. (Free verse)
- Before. (Sonnet)
- Operation. (Free verse)
- After. (Sonnet)

The poems ‘Suicide’ and ‘Operation’ are set out below. The others can be sourced from the bibliography.

Suicide

Staring corpselike at the ceiling,
See his harsh, unrazored features,
Ghastly brown against the pillow,
And his throat so strangely bandaged!

Lack of work and lack of victuals,
A debauch of smuggled whisky,
And his children in the workhouse
Made the world so black a riddle

That he plunged for a solution;
And, although his knife was edgeless,
He was sinking fast towards one,
When they came, and found, and saved him.

Stupid now with shame and sorrow,
In the night I hear him sobbing.
But sometimes he talks a little.
He has told me all his troubles.

In his broad face, tanned and bloodless,
White and wild his eyeballs glisten;
And his smile, occult and tragic,
Yet so slavish, makes you shudder!

Operation

You are carried in a basket,
Like a carcase from the shambles,
To the theatre, a cockpit
Where they stretch you on a table.

Then they bid you close your eyelids,
And they mask you with a napkin,
And the anæsthetic reaches
Hot and subtle through your being.

And you gasp and reel and shudder
In a rushing, swaying rapture,
While the voices at your elbow
Fade — receding — fainter — farther.

Lights about you shower and tumble,
And your blood seems crystallising —
Edged and vibrant, yet within you
Racked and hurried back and forward.

Then the lights grow fast and furious,
And you hear a noise of waters,
And you wrestle, blind and dizzy,
In an agony of effort,

Till a sudden lull accepts you,
And you sound an utter darkness . . .
And awaken . . . with a struggle . . .
On a hushed, attentive audience.

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Invictus

Very importantly, whilst in hospital, WEH wrote another untitled poem (not part of the *In Hospital* collection) which was also published in *A book of verses* (1888). It was untitled and later dedicated to the memory of Robert Thomas Hamilton-Bruce (1846-1899) who, after WEH had left hospital but before the *Book of Verses* was published, supported him with both finance and friendship. The poem was renamed *Invictus* by Arthur Quiller-Couch and published under his editorship in the first edition of *The Oxford Book of English Verse, 1250 – 1900*; (Oxford, Clarendon Press,1900). The poem is freely available on the internet.

Sir Anthony Jephcott's Macintosh Laryngoscope Cufflinks

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In 1942 Anthony Jephcott enrolled as a medical student at St John's College, Oxford, where during WW2 he joined the Science Area Fire Brigade which included members of the Physiology Department and its workshops.

Robert Macintosh, who had an adventurous WW1 in the Royal Flying Corps and as a POW [1], was the relatively new Professor at Oxford and an Air Commodore in the RAF at the time. He had been charged with developing a vaporiser for the anaesthetic chloroform for the RAF. This task was aided by the transfer of Stanley F Suffolk from his position as Lecturer in Physiology to the Department of Anaesthetics to work with Macintosh and HG Epstein. This collaboration overwhelmed the anaesthetic workshop facilities which brought FH Gardiner and colleagues into the research area from the Physiology Workshop.

It soon became apparent that a dedicated production line would be necessary to produce the vaporisers in quantity, and so Longworth Scientific Instrument Co Ltd was formed in June 1943 by Gardener, I Owen and J Mumford (all from the University's science area workshops) to produce the vaporisers. These were also produced in numbers (about 3000 vaporisers) by Morris Motors Ltd in Oxford. Macintosh had developed his laryngoscope by this time with the assistance of Richard "Dick" Salt and this laryngoscope, though initially made by MIE, was also being produced by the Longworth Scientific Instrument Co.

In 1944 when he failed his anatomy examinations, Jephcott enrolled in the Royal Electrical & Mechanical Engineers (REME) where he gained valuable experience in basic workshop practice and a knowledge of electronics [2]. At the end of WW2, in 1946, he reconnected with Gardiner and Suffolk and became interested in the development of Longworth Scientific Instrument Co. This interest was soon interrupted by a transfer to Egypt with the Royal Army Education Corps (RAEC), where six months later he was struck by poliomyelitis and was repatriated to England at the turn of the New Year in 1947.

During these WW2 service years his father Sir Harry Jephcott (1891-1978), then Managing Director of Glaxo plc, had continued contact with Longworth Scientific Instrument Co where he had purchased some shares on behalf of Anthony. Anthony was immediately back in contact with Gardiner on his return to England. However, because of his resolving polio issues it was decided that he should take a recuperative sea voyage to Australia and New Zealand where he could investigate the commercial possibilities for Longworth's medical equipment. His parents had many contacts there through Sir Harry's Glaxo connections. On this voyage Jephcott took an interesting book (*Anaesthetic Methods* by Kaye, Orton & Renton), which was a new Australian textbook on anaesthesia, particularly general anaesthesia [3]. This book and meeting its authors in Melbourne convinced Jephcott that there was a future for him in Longworth.

During these early post-war years Longworth had outgrown its Oxford premises and had leased The Old Carpet Factory on Nag's Head Island in the Thames at Abingdon, Oxfordshire. On his return from Australia and New Zealand, Jephcott joined Longworth as the third Director (with Gardiner and Suffolk), and enrolled for a BCom at the London School of Economics (LSE). He completed this degree in 1951 at which time he joined the company as Managing Director.

In the early to mid-1950s a number of Longworth's staff left to form their own companies – FH Gardiner (Pentland Instruments, Oxford); I Owen and J Mumford (Owen Mumford Ltd, Woodstock); and HG East (East & Co, Oxford). Charles King in London referred to this fracturing as "Longworth and its splinter groups"! In 1954 Longworth spawned a subsidiary company specifically to manufacture ironing boards (Andersay) which proved to be another financial lifesaver for the company. In 1959 Longworth purchased Pentland Instruments Co Ltd and formed Penlon. At the same time they built a new factory on purchased land in Abingdon. Ray Sugg and Neville Ripley joined Penlon at this time. Sugg joined from his family's firm (William Sugg & Co Ltd) which had been responsible in the Victorian era for the installation of street gas lamps, particularly in London but even in Llandudno where one is still in use today.

Jephcott bought himself out of Penlon in mid 1973 with an agreement allowing him to start the New Zealand firm PenMedic, which he subsequently sold in 1977 and which was liquidated in 2006. Six months after Jephcott left, Penlon was sold to Thomas Tilling Ltd with its Division

of InterMed which was subsequently taken over by BTR plc in 1983. Penlon became an independent company again in 1966 following an internal management buyback, and acquired East Healthcare the following year which had originally been HG East & Co Ltd . Penlon was sold to BPL Medical Technologies in 2015, and later was absorbed into Medcaptain Medical Technology Co Ltd, where Penlon lives on as a subsidiary of the main company.

Anthony Jephcott, at the time of his retirement from Penlon in 1973, arranged for six sets of gold cufflinks to be produced by Payne & Son, Jewellers of Oxford, with an etching of the Macintosh laryngoscope on the face of the cufflinks (Fig 1). These cufflinks were gifts for colleagues associated with Penlon and to recognise the major contribution that the Macintosh Laryngoscope had been to the success of Longworth/Penlon.

Figure 1. Set of cufflinks

*(*Interestingly the etchings demonstrate *one detail* that *invariably escaped the plagiarists. The curve of the true Macintosh blade is not regular; indeed, the chromium plated brass ones being made by us until 1958 had a distinctly flat section about the region of the lamp. This greatly contributed to visualisation of the vocal cords; on the principle that one cannot see through the top of a hill, the top was flattened, but this subtlety was invariably missed by untutored competitors. It became less evident when we started to use stainless steel for the blades, this material being less malleable than brass* [2,4].

These six sets were distributed to Sir Harry Jephcott (whose financial loans had been vital to Longworth's early survival); Sir Robert Macintosh (for his original innovation of the laryngoscope blade); Ray Sugg (Production Director and later Research and Development Director); Neville Ripley (Managing Director); Errol Midwinter (Company Secretary and Accountant); with one set for himself (as CEO Penlon) [Figs. 2 & 3].

Figure 2. Neville Ripley, Anthony Jephcott & Ray Sugg. (during a morning conference at Penlon in 1964 [2].

Figure 3. Errol Midwinter (courtesy of Ray Sugg)

There are other interesting connections worth noting between the cufflinks and the Macintosh laryngoscope. Firstly, there is a connection with John Ritchie who retired in 1974 from his position as Associate Professor and Director of Anaesthesia at the Dunedin Hospital just before I was appointed as the inaugural Professor of Anaesthetics, Otago University, and Chairman of the Dunedin Hospital Department of Anaesthetics. John Ritchie published a modification of the laryngoscope in 1956 to make the light carrier removable for sterilisation [5]. This, though not a major contribution to the evolution of the Macintosh laryngoscope, was just one of the many innovations he contributed to anaesthesia [6]. Another which may be more familiar was The Ritchie Whistle which became a standard monitor for the oxygen pressure circulating in an anaesthetic machine [7]. It was produced by Penlon who continued during my time in Dunedin to remit royalties to the Anaesthetic Department there annually.

In 1951 Sir Robert Macintosh whilst on a world tour met Ritchie when he was in New Zealand, and in his diary commented on his impressions of Ritchie [8]:

> *Collected John Ritchie to take him to his country place at Moeraki. He is pleasant but second rate. I doubt whether he will hold his job down. He got his DA about 1938 but he knows very little about the problem, is on insecure ground…… I think the real trouble is that Ritchie does not know his job, and therefore, does not feel secure in his demands or tenure of office. He is a very nice chap, aged about 45, who should spend more time abroad.*
>
> *To Morkane's house at Christchurch where we had a splendid dinner with Taylor (ex-Waitaki), part-time Director of Anaesthetics, but indecisive, and like Ritchie is untrained and unsuited to hold down the job.*

Macintosh was usually a very good judge of character but I do believe he seriously underestimated John Ritchie who could appear to be pedantic and "old womanish" at times, but who did make substantial contributions to New Zealand and in fact world anaesthesia [6,7]. He was a slow but very safe anaesthetist who was revered in Dunedin. Sir Charles Hercus in his definitive history of the Otago Medical School commented on Ritchie's appointment as Director that;

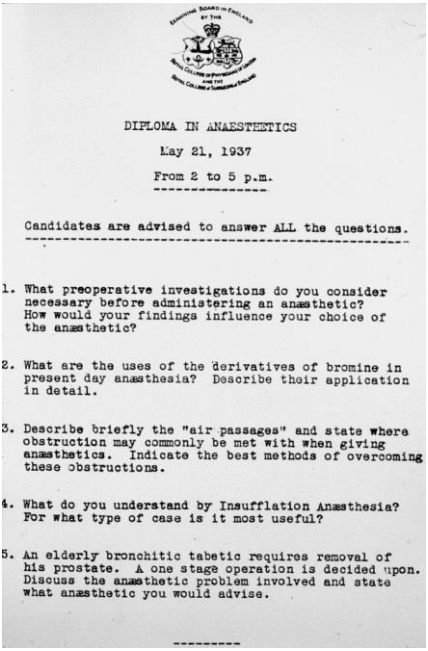
> *He had given long service to the Hospital as second in command, had proved his worth, and was selected from a field including overseas candidates, a selection more than justified by the success of his tenure* [9].

Secondly I have heard a number of different reasons for Sir Robert changing his name from Rewi Rawhiti (his birth name) to Robert Reynolds Macintosh. Lady Macintosh in a letter to me in April 1996 commented that:

> *Mac always said he changed his Christian names from Rewi Rawhiti to Robert Reynolds when he qualified after the First World War, because he thought having two Maori names could be a disadvantage to his medical career in Britain.*

I am not certain that this explanation is completely correct, as I have heard it suggested that he was advised by Victor Goldman (of draw-over vaporiser fame) that English sounding names would be more acceptable than Māori

names for a professional practice in anaesthesia in London! I am not sure if this was so, but I am aware that Victor Goldman was one of several unsuccessful overseas applicants for the Directorship of the Dunedin Department that John Ritchie was appointed to in 1949 [6]. This is an interesting connection when considering the comments in Sir Robert Macintosh's 1951 Diary [8]. With respect to Sir Robert's comments that he *should spend more time abroad*, Ritchie had spent time (1935-7) at St George's and Queen Charlotte's Hospitals in London and at the Rotunda in Dublin, and as an assistant to Ronald Jarmin and his surgeon Lawrence Abel in London. He had also passed the fourth DA Examination in May 1937 [Fig. 4] becoming the first New Zealander to succeed in this examination, though GFV Anson of Auckland had been "grandfathered" a DA along with 65 others [10].



DIPLOMA IN ANAESTHETICS

May 21, 1937

From 2 to 5 p.m.

Candidates are advised to answer ALL the questions.

1. What preoperative investigations do you consider necessary before administering an anæsthetic? How would your findings influence your choice of the anæsthetic?

2. What are the uses of the derivatives of bromine in present day anæsthesia? Describe their application in detail.

3. Describe briefly the "air passages" and state where obstruction may commonly be met with when giving anæsthetics. Indicate the best methods of overcoming these obstructions.

4. What do you understand by Insufflation Anæsthesia? For what type of case is it most useful?

5. An elderly bronchitic tabetic requires removal of his prostate. A one stage operation is decided upon. Discuss the anæsthetic problem involved and state what anæsthetic you would advise.

Figure 4. Ritchie's DA Examination paper 1937 (from Ritchie Archives Dunedin, New Zealand)**.**

Sir Harry Jephcott died in 1978 and Anthony became the 2nd Baronet of East Portlemouth, Devon. The Faculty of Anaesthetists, Royal Australasian College of Surgeons, elected Sir Anthony to Honorary Fellowship in 1990, and this was converted to Honorary Fellowship of the Australian and New Zealand College of Anaesthetists (ANZCA) in 1992 at the foundation of ANZCA for *his outstanding contribution to anaesthesia as a manufacturer of anaesthetic equipment and for his support of local manufacture in this region particularly in New Zealand* [11].

Sir Anthony Jephcott (Fig. 5) died in Auckland in 2003 at the age of 79, with the Baronetcy passing to his brother Neil, and subsequently to Neil's son David as the current Fourth Baronet of East Portlemouth, co. Devon.

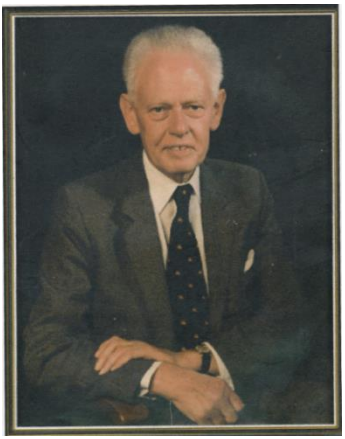


Fig. 5. Sir Anthony Jephcott Bt 2000. (Courtesy Lady Jo Jephcott).

The cufflinks are now owned by:

Sir Harry Jephcott	→	**Lady Jo Jephcott ***
Sir Robert Macintosh	→	**Guy Francis (step-son)**
Ray Sugg	→	**Philip Sugg (son)**
Nevill Ripley	→	**Guy Ripley (son)**
Errol Midwinter	→	**Errol Midwinter (one cufflink lost!)**
Sir Anthony Jephcott	→	**Barry Baker**

*(deceased with the provenance of these cufflinks currently uncertain)

Acknowledgements

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George Mahood Foy (1843 – 1934): surgeon, author and advocate for Crawford Williamson Long

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Early life

George Mahood Foy (Figure 1), the youngest of seven children of John Foy, a merchant, and his wife Joan, was born December 26th, 1843 in Cootehill, Co. Cavan, Ireland. In 1869 he entered Queen's College, Belfast where he studied chemistry, natural philosophy, natural history, Celtic languages, anatomy and physiology.

Figure 1. Photograph of George Mahood Foy FRCSI. (Reproduced from Taylor FL, Crawford W. Long and the Discovery of Ether Anesthesia, Paul B. Hoeber Inc., 1928. *By kind permission of Wolters Kluwer.)*

George moved to Dublin after two years to receive professional training in various medical schools and hospitals and obtained a licence in 1873 to practice medicine from the city's Apothecaries Hall. Foy became both a Licentiate and a Fellow of the Royal College of Surgeons in Ireland in the following year. During this time he was also appointed as Lecturer in anatomy, physiology and jurisprudence at the Carmichael School of Medicine in Dublin.

George Mahood Foy was elected surgeon to the Whitworth Hospital, Dublin (now the headquarters of the National Council of the Blind of Ireland) in 1876. A linguist, fluent in seven or eight languages, he was also an avid reader and prolific author who, in addition to writing and translating numerous papers, scientific and lay, corresponded regularly with medical and popular press publications on both sides of the Atlantic Ocean. He was interested in history from childhood and his 1885 paper "Science and Civilisation: their influence on pharmacy" contained the sentence '*Ether, which is so much used as an anæsthetic, was first used for this purpose by Dr Morton, of Boston, during tooth extraction, in 1846'*[1]. It can be inferred therefore, that in 1885, Foy was unaware of Dr Crawford Williamson Long's administration of the agent in Jefferson, Georgia to James Venable to relieve the pain of surgery on March 30 1842, over four and a half years prior to William Thomas Green Morton's first public demonstration in the Massachusetts General Hospital [2].

Between October 1888 and June of the following year no fewer than eight articles on "Anaesthetics" by George Foy were published in the *Dublin Journal of Medical Science*. This series soon appeared in book form, with the lengthy title and subtitles:

> '*Anaesthetics Ancient and Modern: their Physiological Action, Therapeutic Use, and Mode of Administration; together with an Historical Resumé of the Introduction of Modern Anaesthetics – Nitrous Oxide, Ether, Chloroform and Cocaine; and also an Account of the more Celebrated Anaesthetics in use from the Earliest Time to the Discovery of Nitrous Oxide*'[3].

Hunter Holmes M'Guire

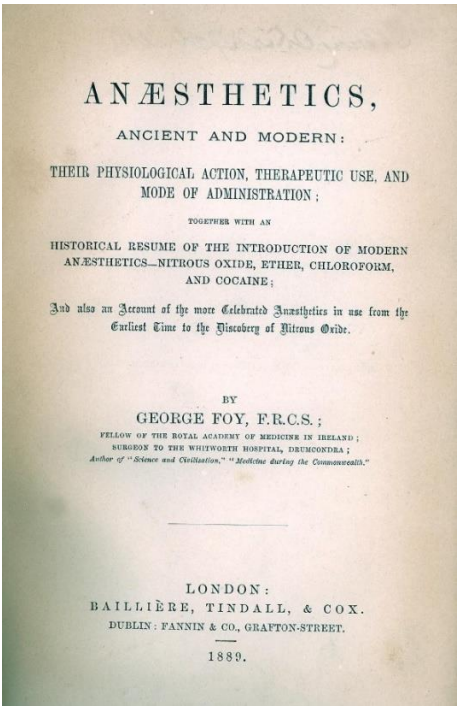
Foy dedicated his book on anaesthetics to the American surgeon Hunter Holmes M'Guire. Born in Winchester, Virginia in 1835 and having studied medicine there and later in Philadelphia, M'Guire returned to his native state shortly before the outbreak of the American Civil War in April 1861. Shortly after the beginning of the conflict he became medical director of Thomas Jonathan 'Stonewall' Jackson's command and accompanied the general through the Shenandoah Valley campaign of 1862. In May of the following year, after Jackson had accidentally been shot by his own side at the Battle of Chancellorsville, M'Guire amputated his left arm under chloroform anaesthesia in a vain attempt to save his life [4]. Following the war M'Guire practiced in Richmond. He would go on to become one of the most prominent surgeons in the USA, and was elected as president of the American Surgical Association in 1886, and of the American Medical Association seven years later.

M'Guire had visited Dublin in August 1878 and, while there, had met George Foy [4]. The Irish surgeon honoured his American counterpart by presenting him with a complete first-edition set of Edward Jenner's rare monographs on vaccination. This marked the beginning of an enduring friendship between the two, and may also have been the catalyst for Foy's interest in the American Civil War on which he was to become an authority, albeit one whose opinions invariably supported the Confederacy. Following M'Guire's death, his son presented the Jenner set to William Osler as a memento of his father and in 1937, William Francis, librarian at the famed Osler Library in Montreal, described the item as being one of the treasures of the entire Osler collection [5].

Anaesthetics Ancient and Modern

Foy's book (Figure 2), the first on the subject written by an Irish doctor working in his native country, commences with an extensive account, extending to five chapters and sixty pages, of the evolution of attempts to provide painless surgery - this section could be considered to contain the first detailed account of early anaesthesia history. By the time of writing, Foy had become aware of Crawford Long's early use of anaesthetic ether and commented "*From deficient inter-State communication in 1842, Dr Long's*

operation remained unknown until the 1847 controversies of Wells, Morton, and others, caused the past records to be examined". Later chapters address the advantages and disadvantages of various anaesthetic agents and techniques, including local anaesthesia. Foy concluded with a list of 'rules' (his word) on the administration of anaesthetics and an extensive series of illustrations, with descriptions, of contemporary anaesthesia apparatus.



ANÆSTHETICS,

ANCIENT AND MODERN:

THEIR PHYSIOLOGICAL ACTION, THERAPEUTIC USE, AND MODE OF ADMINISTRATION;

TOGETHER WITH AN

HISTORICAL RESUME OF THE INTRODUCTION OF MODERN ANÆSTHETICS—NITROUS OXIDE, ETHER, CHLOROFORM, AND COCAINE;

And also an Account of the more Celebrated Anæsthetics in use from the Earliest Time to the Discovery of Nitrous Oxide.

BY

GEORGE FOY, F.R.C.S.;

FELLOW OF THE ROYAL ACADEMY OF MEDICINE IN IRELAND;
SURGEON TO THE WHITWORTH HOSPITAL, DRUMCONDRA;
Author of "Science and Civilisation," "Medicine during the Commonwealth."

LONDON:
BAILLIÈRE, TINDALL, & COX.
DUBLIN: FANNIN & CO., GRAFTON-STREET.

1889.

Figure 2. Title page of George Mahood Foy's *Anaesthetics, Ancient and Modern*, 1889.

1892 Visit to Richmond, Virginia

The Heritage Centre in the Royal College of Physicians of Ireland holds a scrapbook consisting mainly of newspaper cuttings of articles and letters dating from 1886 to 1903, mostly written by George Foy and undoubtedly compiled by him. The collection includes a cutting of a letter that he sent to the *Dublin Evening Mail* in September 1902 which contains a sentence

referring to a visit to Richmond, Virginia made by him ten years earlier. More detail is provided in an article in the Richmond Dispatch of September 30th 1892: '*Dr Hunter M'Guire, accompanied by his friend Dr George Foy, of Dublin, Ireland, reached this city yesterday afternoon at 2.38 o'clock, after an extended trip abroad. Both gentlemen arrived in New York Wednesday. They had a delightful voyage across the Atlantic on the White Star steamer Teutonic'*[6].

M'Guire had been on another visit to Britain and Ireland, in part to visit his ancestral home in Enniskillen, Co. Fermanagh. He was joined for the return sailing from Cobh, Co. Cork by Foy – the Teutonic covered the journey of 2,771 miles to New York in the remarkable time of just five days, twenty-one hours and eight minutes [4]. The Richmond Dispatch went on to quote M'Guire

> '*I brought back with me one of the most prominent surgeons in Great Britain – Dr George Foy. He is so much interested in the South that he came over just to see some of our battlefields in Virginia. I was very much surprised to find that he has even more literature about the South than I have. His familiarity with the history of the Old Dominion is wonderful'*.

On this occasion, it was M'Guire who presented Foy with a gift, an inscribed leather-bound set, with inscription, of the Confederate States Medical and Surgical Journal, 1864-5. Having been donated as part of his extensive collection to the University's Medical School in 1958 by Dr Lawrence Reynolds, a radiologist, this particular volume now resides in the library of the University of Alabama at Birmingham. The first issue of the journal was published in January 1864, the fourteenth and last appeared two months before the war ended in April 1865.

Advocate for Crawford Williamson Long

Luther Grandy, a physician of Atlanta, Georgia wrote in 1893 in support of Crawford Williamson Long's claim to recognition as being the first to use ether to relieve the pain of surgery [7]. Long's daughter Mrs Frances Long Taylor later reported that Grandy's paper attracted widespread attention and especially that of George Foy [8]. In 1896 she gave permission to Hugh

Young, a surgeon at Johns Hopkins Hospital in Baltimore, Maryland to examine documents written by or relating to her late father. Young's resulting paper was reviewed by Foy for *Janus*, a Dutch journal of the history of medicine and science. Having also received assistance from Mrs Taylor, Foy published, once more in *Janus*, his own paper on Long in 1900. It was comprehensive in that in addition to recounting the Georgian doctor's work and the proofs of same, it went into some detail regarding his Irish ancestry and early life [9]. It was the first detailed account of Long's life, work and claim to priority where anaesthesia for surgery was concerned to appear in any European publication.

Frances Long Taylor and her sister Emma visited the Irish surgeon at his Dublin home in 1903. Following the publication of his 1900 paper, Foy had three copies bound in dark blue leather and stamped in gold. One he retained for himself, he sent the second to King Edward VII, who had undergone drainage of an appendix abscess in 1902 and subsequently developed an interest in anaesthesia, while the third was presented by him to the two sisters during their Dublin visit (Figure 3).

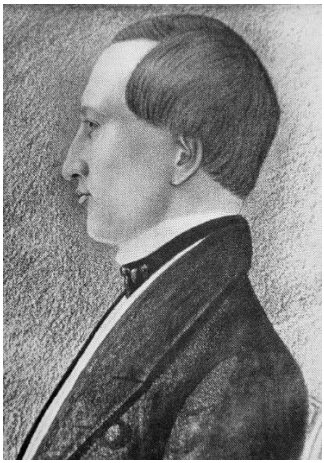


Figure 3. Dr Crawford Williamson Long, aged 26 years. Crayon portrait, drawn by an unknown artist some weeks after Long had administered ether to James Venable).

George Foy's association with the Long family continued. The 1910 annual meeting of the British Medical Association (BMA) was held in London in late July. Following discussions with Frederic Hewitt, President of the Anaesthetic Section of the BMA in June of that year, Foy had written to Mrs Taylor inviting family members to come to London to exhibit material relating to Crawford Long at the meeting. She later wrote '*This was an honour we could not decline and, catching the first steamer, we sailed*' [8]. The "we" for this trip were Frances again and another of her sisters, Mrs Florence Long Bartow. Twenty items relating to Long's early work with ether anaesthesia, the majority of which were either originals or certified copies of affidavits and certificates, were subsequently exhibited at the Medical Museum held in the Imperial College of Science, South Kensington in association with the BMA meeting. They attracted much interest, and were discussed with the sisters by the leading British anaesthetists of the time, including Hewitt, Frederick Silk, Harold Bellamy Gardner, and Dudley Wilmot Buxton. Some months later, Foy wrote

> '*Today, December 24 1910, I am thankful to say that Dr C.W. Long is acknowledged as the discoverer by every one of our anaesthetists in Great Britain and my arguments in his favour have been translated into all the principal languages in Europe. Of one great fact I am sure, to wit; the principal anaesthetists of London recognise his claim to the discovery of general anaesthesia as well-founded and in their hospital classes they so inform their students*' [8].

Buxton delivered his paper '*Crawford Williamson Long: the pioneer of anaesthesia and the first to suggest and employ ether inhalation during surgical operations*' at a meeting of the Section of Anaesthetics of the Royal Society of Medicine in late 1911; it was subsequently published in the Proceedings of the Royal Society of Medicine [10]. He included two acknowledgements '*I desire to express my thanks to Mrs Long Taylor, through whose kindness I have been furnished with documentary evidence of the accuracy of the facts I have advanced about her father Crawford W. Long,* and *to Dr George Foy, of Dublin, to whose unique knowledge of this matter and collection of memorials of Crawford Long I have been most generously made welcome*'. Foy's own final publication on Long appeared

in January 1916 – it was written to mark the centenary two months earlier of the Georgian's birth [11].

Honours etc.

During his lifetime, Foy was accorded a number of honours in the USA. In 1895, he was one of the first five persons to become honorary members of the Southern Surgical and Gynaecological Association. The other four were prominent surgeons based in Paris, Berlin, Brussels and Naples [12]. Two years later he was conferred with a doctorate in medicine, honoris causa, by the University of Virginia; he was the first to be so-honoured. He was also elected to honorary membership of the Medical Societies of both Virginia and Georgia. Frances Long Taylor, in her 1928 biography of her late father described him as having the most vigorous and versatile mind of any man she had ever known and referred to his work on Long's behalf as *'his espousal of such an apparently hopeless cause as my father's appeared to be in the 1880s*' [8].

George Foy married Mary Jane Montgomery in December 1899. The only child of their marriage, a son, was born three months after the death of Hunter Holmes M'Guire in September 1900. The boy was named Charles Hunter McGuire Foy after his father's friend but lived for just two years. Following his retirement from surgical practice, Foy continued to contribute occasionally to medical and other journals. He died in Dublin on April 23rd 1934.

Addendum

Since the presentation of this paper on October 11th 2023 at the History of Anaesthesia Society Annual Scientific Meeting in Llandudno Wales, the following information. of which they were not previously aware, has come to the attention of the authors.

A leader in the eugenics movement concerned with the control and reduction of ethnic minorities who also remained a lifelong defender of the Confederate 'Lost Cause' narrative, Hunter Holmes M'Guire saw black people as inferior to whites and was of the view that African Americans were deteriorating both morally and physically and would eventually disappear

from the American continent [13]. While President of the American Medical Association, in a now infamous 'open letter' published in 1893 by the Virginia Medical Monthly, he asked for some scientific explanation of what he termed the 'sexual perversion of the Negro' of that time. His correspondent, Chicago physician G. Frank Lydston replied that hereditary influences were a factor and suggested surgical castration of criminals in order to prevent perpetuation of their kind [14].

Sparked by George Floyd's death at the hands of Minneapolis police some weeks previously, protests against racial inequality in the USA in the summer of 2020 led to pressure to remove memorials to leaders of the Confederacy. M'Guire had helped found and been the first President of the University College of Medicine (UCM) in Richmond and also its first Professor of Surgery−UCM is now part of the Medical College of Virginia Commonwealth University. In the following months, supported by some of his descendants who expressed the hope however that '*history will judge McGuire, a surgeon, based on his complete life and contributions*', the university removed all recognition of M'Guire from its campus – steps taken included renaming a building formerly known as McGuire Hall and removing his bust from another. At the request of veterans, employees and community members, the US Department of Veteran Affairs (VA) changed the name of its hospital in Richmond from the 'Hunter Holmes McGuire VA Medical Center' to the 'Richmond VA Medical Center' in January 2023, thus relegating M'Guire to history. It had been the only major VA facility named for a member of the Confederacy [13,15]. A large statue of the surgeon on the State Capitol grounds in Richmond remains.

A full-page letter written by George Foy in response to an editorial in an earlier issue which criticised southern Americans for lynching their black countrymen was published on June 30 1894 in *Dublin Figaro*, a conservative 'upper-class' society magazine of the time. He wrote that it would be better if the processes of the law were resorted to rather than appeal to 'Judge Lynch'. However, he also pointed out that in civilised countries, the injured is at times permitted to punish the offender−he gave as an example the extreme case of where a burglar who threatens life may be shot in self-defence. He continued, using language and phraseology that would certainly not be published in 2023, to disparage African Americans and described in detail two recent particularly abhorrent crimes against children, the alleged

black perpetrators of which were subsequently killed by lynching. Foy suggested that the children had been targeted because attempts to violate women in the southern US states were being increasingly frustrated by the fact that some had taken to carrying revolvers. In the same issue, Dublin Figaro's editor penned a lengthy rebuttal of what he termed the doctor's endeavours to palliate the crime of lynching [16,17].

The authors of the current manuscript have faithfully recorded the views and beliefs of Drs George Foy, Hunter Holmes M'Guire and G. Frank Lydston which are established in published records from the era in which they were written. They represent those persons' views and not those of the authors who believe that a historical review should allow publication of the beliefs of others to enable appropriate discussion. While such views are abhorrent in a modern multicultural world, the authors believe that censorship of views from previous centuries in the hope of achieving some form of modern political correctness only distorts the history.

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What might he have achieved?
A Manchester Anaesthetist dies young[1]

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Abstract

Sidney Rawson Wilson was born on July 13 1882 in Penistone, near Barnsley where his father, Arthur Cobden Jordan Wilson was a GP. After attending Penistone Grammar School, he went to Owens College where he was awarded a Dauntesey Medical Scholarship. In 1905 he qualified MB BCH from Manchester and MBBS from London, with honours from both Universities. The following year he was appointed a Surgical Houseman at the Manchester Royal Infirmary. In the following year (1907) he wrote a paper on Mule Spinner's cancer which was awarded the Tom Jones Surgical Scholarship Prize. In that same year he was appointed anaesthetist to Manchester Royal Infirmary and provided anaesthesia services at Ancoats Hospital and the Dental Hospital. He married in the same year and became chief anaesthetist at the Manchester Royal Infirmary providing services at Pendlebury Children's Hospital and the Ear Hospital.

Sidney Rawson passed the FRCS at Edinburgh in 1910. He was appointed Captain RAMC on the staff of the 2nd Western General Hospital, Whitworth Street in Manchester at the onset of war in 1914 and maintained his interest in the Red Cross becoming Commandant of the 5th East Lancashire Senior Red Cross Men's Detachment. After the war he assisted in the reorganisation of the Physiology Department of the University of Manchester and was appointed Lecturer in Human Physiology. He maintained a busy anaesthesia schedule and in 1921 published in the Lancet a report of a new invention, a Warm Ether Bomb, for which a patent had been obtained in 1918. The device became known as Pinson's Bomb. He and a fellow physiologist,

[1] This abstract is based on the following forthcoming publication in the British Journal of Anaesthesia

Wilkinson DJ. Sidney Rawson Wilson: why some are remembered, and some are not. British Journal of Anaesthesia 2023; 131: e69-e71.
https://authors.elsevier.com/a/1hOW%7E1dCDr01d
With kind permission of the Editor, British Journal of Anaesthesia

McSwiney, published in the Lancet in 1922 about an improved method of inducing anaesthesia in animals which utilised this bomb.

Wilson helped Hyman Cohen and Henry Boyle initiate the British Journal of Anaesthesia in 1923 and became Treasurer and Honorary Secretary of the publication. The first few years of the Journal have many papers from Wilson who also published regularly in the BMJ and Lancet as well as writing a book on anaesthesia. He was a noted teacher and very fine lecturer and was particularly commended for his lectures on the history of anaesthesia.

A group of American anaesthesiologists visited the UK in 1926 and amongst them was Elmer McKesson. Whilst in Manchester McKesson presented Wilson with his latest nitrous oxide/oxygen apparatus and Wilson took it home to progress his experiments. He was trying to find a combination of nitrous oxide and oxygen that would create a prolonged analgesic phase without unconsciousness. During one such experiment in his home study he was found dead on the floor by his wife with a mask strapped firmly to his face. His death shocked doctors around the world and long obituaries were written in the BJA and echoed in the BMJ, Lancet and in medical journals and newspapers across America and Australia.

Paediatric anaesthesia in Japanese in the 1830s

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Introduction

Seishu Hanaoka (Fig 1) was born in 1760, in Kinokawa,Wakayama, Japan. In 1782, he went to Kyoto for two years to learn classical surgery. Afterwards, Seishu stayed in Kyoto for another year, buying medical books and medical devices. In 1785, Seishu returned to his hometown in 1785 and started a medical practice.

Figure 1. Seishu Hanaoka

Because he wanted to alleviate the pain and suffering of patients and to save people's lives through surgery, he continued to research and develop anaesthetics, about which he had been dreaming since childhood. As a result, he discovered that six types of medicinal herbs containing Datura stramonium and Aconitum as a main active component had an anaesthetic effect. Based on this discovery, he successfully developed Mafutsusan.

On 13th October 1804, Seishu Hanaoka successfully operated on Kan Aiya, a 60-year-old woman to remove breast cancer under general anaesthesia, using Mafutsusan. The surgery carried out by Seishu appears to be the world's earliest case of surgery under anaesthesia to have been verified as an actual case, because the following:

-the surgery was performed under general anaesthesia;
-the patient's name is known;
-the name of the surgeon is known;
-the indication for the surgery is known;
-the surgical procedure performed is known;
-the date of surgery is known.

After that, other surgical procedures that he performed using Mafutsusan included removal of bladder stones, tumor resections, haemorrhoidectomies, and treatment of gangrene [1-3]. His fame spread across Japan and he was inundated with requests from patients and prospective students. Therefore, he founded a private medical school (Shunrinken) in his hometown (Figure 2). He trained more than 1000 students at his medical school.

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Figure 2. Seishu's Medical School Builing in Kinokawa

Because Seishu did not record his medical knowledge or techniques in any books and availability of few studies of Seishu and his disciples about the paediatric anaesthesia, the writings of Gencho Honma and Gendai Kamada are important resources for investigating the value of Seishu's medical knowledge and techniques. The descriptions about Hanaoka-style paediatric anaesthesia and surgery in Japan are also clarified.

Sources, Methods and Results

The achievements of Seishu Hanaoka and his disciples were collected from books, abstracts, articles and websites on the history of anesthesiology and the medical history mainly from archives at Japanese Anaesthesia Museum. Descriptions about paediatric anaesthesia from these were extracted and analysed.

Two descriptions about pediatric anaesthesia were found, these being "Yokahiroku" and "Mafutsutoron". The authors of the two descriptions were both Seishu's disciples. Yokahiroku was written by Gencho Honma in 1837 (Figure 3) [4]. It was a ten volume surgical text book. The description of paediatric anaesthesia for cleft lip repair is given a chapter in Volume 4.

Figure 3. Gencho Honma

Gencho was a Japanese surgeon in the middle of the 19th century. He learned and mastered surgical and anaesthetic techniques at Shunrinken. After that,

he went to Nagasaki and learned medicine from Siebold as well. Later he wrote

> *'Hanaoka is the only person in the world who claims to be the greatest in the world. As for the treatment, there is a person named Siebold, a Dutch doctor, who also provides treatment although what he does is extremely strange. I have no idea if he is the person above Hanaoka.' According to Gencho, Seishu is superior to Siebold in treatment [5].*

In the description, Gencho stated,

> *"We must not use Mafutsuto for children five years or younger but can be used in those six years old or more. As for some children, a deep coma state comes suddenly. And some children are hard to wake up and an unconsciousness continues for two or three days. Therefore, when we use this medicine to children, we give it very carefully. A child, 10-15 years old, should be given the 80% of an adult dose, and those 6-10 years old, should be given 50%."*

The second description matched "Mafutsutoron" written by Gendai Kamada in 1839 (Figure 4) [6].

Figure 4. Gendai Kamada

Mafutsutoron was a text book for clinical anaesthesia, included 10 pages, 80 sentences, and 2000 characters. The description of paediatric anaesthesia could be found on pages 4 and 5. In the description, Gendai said:

> *"As for the dose of Mafutsuto, children 6-10 years old, should be given 25-50% dose of adults, and those 10-16 years old, 50-75% of the adult dose. However, caution should be exercised because there is an individual difference in response. The two-thirds breakfast was given at the usual time and Mafutsuto given before noon. The patient attains an anaesthetic state within two hours. We have to try again on a different day if Mafutsuto doesn't work. In that case, the dosage is increase and given with some liquor"*

Dr Kamada describes a request he received for a child who had suffered burns a year before. A half dose of Mafutsuto given to him did not result in an anaesthetic state after approximately one hour. Another half dose was given with some liquor, but Mafutsuto was still ineffective. One further dose was still insufficient for performing surgery which was then postponed. Some days later, the patient was brought back and administered 150% of the dose of Mafutsuto with warm liquor which produced the desired anaesthetic state. This is not unusual in children in whom Mafutsuto is hard to work with.

The auther of Mafutsto, Gendai Kamada, was a Japanese surgeon in the first half of the 19th century . He was an outstanding disciple of Seishu Hanaoka, and one of his followers who spread the anaesthetic and surgical procedures developed by Seihyu. From the perspective of the history of anaesthesia, three of Gendai's achievements had a global impact:

1. He wrote the first textbook of clinical anaesthesia;
2. He was the author of one of the oldest illustrations of surgery under general anaesthesia; and
3. Trained the second anaesthesiologist in the world [7-9].

The first report of Hanaoka-style paediatric anaesthesia in English was described in 1992 by Iwai and Satoyoshi [10]. Iwai was one of the founders of paediatric anaesthesia in Japan. He highlighted Gencho Gendai's work in this report as this work was not well-known in Japan at the time.

Gendai Kamada, who wrote Mafutsutoron, was an early disciple of Seishu Hanaoka, and Gencho Honma, who wrote Yokahiroku, was a late one. They were both excellent surgeons. Around the time of Seishu's death, the Hanaoka-style physicians were confused about anaesthetic methods and surgical techniques. This was because Seishu did not leave any writings of his own. To reduce this confusion, soon after Seishu's death, Gendai and Gencho retained writings about Hanaoka-style anaesthesia. The contents of these two writings are almost the same. The reason for the longer description by Gendai is because he added the report one case where it was difficult to perform general anaesthesia [11].

Following the discovery of inhalation anaesthesia, John Snow performed many paediatric cases and his paediatric anaesthesia was very safe. He performed 393 paediatric anaesthesia cases, including 186 under one year old with low mortality [12,13]. It appears that inhalation anaesthesia was superior to Mafutsuto in paediatric cases.

Conclusions

We found out two descriptions by Seishu's disciples of paediatric anaesthesia and surgery prior to the introduction of Western anaesthesia. The initial description, 'Yokahiroku' was written by Gencho Honma in 1837 and the second 'Mafututoron' was written by Gendai Kamada in 1839. In Japan, paediatric anaesthesia and surgery in children over the age of five have been performed in Japan from the late 1830s.

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John MacDonnell and the first anaesthetic in Ireland

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The first operation carried out under anaesthesia in Ireland took place on 1st January 1847. John MacDonnell was the surgeon and the procedure took place at the Richmond Hospital, Dublin. The patient was Mary Kane, an 18 year old from Drogheda, a few miles north of the city. She had been collecting firewood when a thorn punctured her elbow and as a result she developed suppurative arthritis of the joint. Her condition had deteriorated over a few weeks to the extent that MacDonnell felt it necessary to amputate her arm to save her life. On the 30th December he had read an account in *The British and Foreign Medical Review* of Morton's use of ether in Boston [1]. MacDonnell decided to try it for Mary Kane's surgery but first he wanted to use it on himself before giving it to a patient.

MacDonnell had an apparatus constructed and then proceeded with the help of one of his colleagues and "rendered myself insensible …. five or six times." He also declared that "at the moment of insensibility I had the feeling of a profound stun, as if from a heavy blow to the head."

On the morning of 1st January, the anaesthetic was administered (though it isn't known by whom) and he proceeded with the amputation. The patient felt no pain and stated "that she had no unpleasant sensation from the inhalation, and that, till, as she says, she saw me put a thread on her arm, she felt nothing."

MacDonnell immediately wrote his account of the procedure, it was published in the 6th January 1847 issue of the *Dublin Medical Press*[2]. In it he wrote "I regard this discovery as one of the most important of the century. It will rank with vaccination and other of the greatest benefits that medical science has bestowed upon man."

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Could Chloroform have been used as safely as Halothane?

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When the halogenated ethane, halothane, was introduced in 1956 as a non-flammable and non-explosive alternative to ether or cyclopropane, comparisons were inevitably made with another existing volatile hydrocarbon agent, the halogenated methane, chloroform. As would be expected from their similar chemical structure, they shared many clinical features in common. Important differences were that sudden cardiovascular collapse due to ventricular fibrillation was common with chloroform and hypotension (proportional to concentration and potentiated by d-tubocurarine) was more common with halothane. Respiratory depression could occur with both agents but was less severe with halothane [1-3].

Chloroform had largely fallen out of favour with specialist anaesthetists in wealthier countries because of its poor safety record, especially as safety during anaesthesia had become a matter of increasing concern in Europe and North America during the 1940s [4-7]. Even so, a survey of Scottish general practitioners in 1948 found that only 2.5 per cent never used chloroform in obstetrics and 47 per cent never used it for major surgery. Of specialists in anaesthesia in England, Scotland and Ireland the percentages who never used chloroform were 16, 15 and 29 respectively [8].

The great majority of deaths attributed to chloroform occurred during the induction period before surgery had even begun or shortly afterwards. It was not until chloroform had been in use for 64 years that Goodman Levy showed that these sudden deaths were due to ventricular fibrillation under light chloroform anaesthesia [9,10]. A much smaller number of cases were a consequence of delayed chloroform poisoning, which will be discussed later. Retrospective data from the 1880s and further retrospective data from 1934 are shown in Table 1. There had been little change between the two studies. We are not aware of any later data, perhaps because chloroform was now less used in Europe and North America, but since the 1930s there had been

several significant advances in anaesthetic practices which could well have been relevant to the safer use of chloroform.

Table 1. Mortality rates attributed to ether and chloroform

Retrospective data	Ether	Chloroform
From 1880s [11]	1:15000 to 1:23000	1:3000
Published 1934 [12]	1:14000 to 1:28000	1:3000 – 1:6000

One such advance concerned the induction of anaesthesia which, until the 1930s, was usually done with the volatile agent, the period when chloroform was most likely to cause death. After the introduction of intravenous barbiturates in the early 1930s maintenance of anaesthesia with nitrous oxide, oxygen and the chosen volatile agent would have commenced after intravenous induction of anaesthesia [13]. In theory this should have reduced the risks from using chloroform during the induction period.

There had also been an increasing realisation of the need for accurate regulation of the concentration of chloroform in the blood and therefore that of the inspired concentration. The Epstein-Suffolk-Oxford (ESO) Vaporizer had been introduced in 1942 by the physicist HG Epstein and chemist SF Suffolk working in conjunction with Professor (later Sir) Robert Macintosh in Oxford. It was a temperature compensated vaporizer intended for use with chloroform because, as so often in wartime, chloroform's portability, non-flammability and non-explosive properties outweighed the advantages of other available volatile agents. In this instance it was designed to be carried by parachutists. We have been unable to discover the smallest increments of inspired vapour which it could deliver but it is known that Epstein thought 0.2 per cent to be more than adequate [11]. However, in an authoritative publication in 1951, Ralph Waters suggested that to make chloroform safe it was necessary to have increments as low as 0.1 per cent. This value was not met by any vaporizer at that time. Waters also stipulated that the chloroform be delivered in an atmosphere enriched with oxygen [14]. In a review of Waters' book the *Lancet* considered that "That the feeling is widespread that to use chloroform when any other method is available borders on negligence" and that "Until there are accurate means of controlling the vapour strength, it (chloroform) will carry inherent hazards even in the hands of a skilled anaesthetist [15].

A vaporizer which could deliver increments/decrements of 0.1 per cent of a volatile agent was the prototype Mark 1 Fluotec, which was manufactured by Cyprane and which was designed for halothane. It was first marketed in 1957, the year after the introduction of halothane and had 0.1 per cent gradations marked from 'Off' to 3.0 per cent [16-18]. However, it was also used for chloroform. The boiling points of halothane and chloroform are 50^0C and 61^0C respectively. Thus at any given temperature the partial pressure, and therefore the concentration of chloroform, will be lower than that of halothane. Comparison of their vapour pressure curves indicated that a calibration correction of 0.75 could be used to convert all concentrations of halothane, as indicated on the Fluotec, to those for chloroform. This correction was recommended by Cyprane until they introduced their Chlorotec vaporizer, which was calibrated for chloroform [19,20].

The dial on the Fluotec Mark 2 vaporizer, introduced in about 1959, was marked from 'Off' to 4.0 per (as opposed to 3.0 per cent on the Mark 1) in 0.5 per cent gradations. It was impossible to deliver less than 0.5 per cent and attempts to set the dial at intermediate positions between the 0.5 per cent gradations would not have guaranteed accurate concentrations [17,21]. The Chlorotec vaporizer was introduced at much the same time as the Mark 2 Fluotec and was marked at 0.5 per cent intervals from 'Off' to 5.0 per cent. Like the Mark 2 it may not have delivered accurate concentrations if the dial was set at positions intermediate between the marked 0.5 per cent gradations. However, as the instrument worked safely in practice, the intervals of 0.5 per cent would suggest that Epstein's estimate of intervals of 0.2 per cent being 'more than adequate' was correct [11].

In 1959 the British anaesthetist Langton Hewer speculated:

> "what might have happened if Simpson had discovered the anaesthetic properties of halothane, and then 110 years later, chloroform had been introduced. Would the drug have been hailed with enthusiasm as avoiding tachypnoea, diminishing hypotension and bradycardia and being sixty six times cheaper…I would like to suggest that a full scale investigation of the similarities and differences of the two drugs *using modern*

techniques (current authors' italics) might be both interesting and profitable" [22].

We have identified five trials, all published between 1960 and 1973 by which time precision vaporizers had been introduced, which aimed to compare the two agents and also two retrospective studies of chloroform alone (Table 2).

Table 2 Studies of chloroform alone or comparing chloroform with halothane 1960-1972

	Author(s)	Year	Halothane (n)	Chloroform (n)
1	Bamforth *et al* [23]	1960	?50	?50
2	Jones [24]	1963	32	29
3	McReynolds *et al* [25]	1963	548	215
4	Oduntan [3]	1969	50	50
5	Smith *et al* [26]	1972	42	58
6	Dobkin *et al* [27]	1961	0	154
7	Whitaker and Jones [28]	1965	0	1502

None were methodologically acceptable by modern standards. For example, some did not define what was meant by a precision vaporizer and some used only the volatile agent for induction, at least in some patients. None had sufficient power to detect an event such as death which might occur only once in 3000 administrations, or even less often. Even the inclusion of two retrospective studies of chloroform alone (numbers 6 and 7 in Table 2) was still insufficient for this purpose. Hewer never got the trial for which he had hoped and probably knew that he never would. Because of the perceived safety issues no one would have provided funding for a large trial involving chloroform.

Any comparison of halothane with chloroform must address the issues of halothane hepatitis and delayed chloroform poisoning.

Type I halothane hepatitis is a mild disturbance of liver function which becomes apparent within 28 days of exposure to halothane. It occurs in up to 30 per cent of those exposed to halothane, is self-limiting and of little consequence. Type II is defined as otherwise unexplained severe liver

damage occurring within 28 days of halothane exposure in a person with a previously normal liver. It may progress to liver failure and is then associated with a high mortality. There is no reliable way of identifying susceptible patients but predisposing features include previous recent exposure, especially multiple exposures, a previous adverse reaction with fever and jaundice, a positive family history, obesity, and female gender [29,30]. These features form the basis of current advice, but some hepatologists consider that the suggested interval of just three months between exposures to halothane is too short [29,31].

There is less information about delayed chloroform poisoning because it occurred predominantly at an earlier time period. Like halothane hepatitis, it affected the liver and could cause liver failure. As it was also a diagnosis of exclusion it was probably over-diagnosed until, and even after, a symptom complex associated with liver failure was recognised in about 1912 [32]. Predisposing factors included significant malnutrition, severe postoperative or postnatal vomiting, dehydration, hypoxia, hypercapnia, acidosis and alcoholism. Preoperative treatment with a high carbohydrate diet, intraoperative glucose and adequate oxygen may have been protective [32,33].

The quoted incidence and mortality rates of Type 2 Halothane Hepatitis and Delayed Chloroform Poisoning vary considerably (Table 3).

Table 3 Incidence and fatality rates of Type 2 halothane hepatitis and delayed chloroform poisoning [30,32,34-36].

	Type 2 Halothane Hepatitis	**Delayed Chloroform Poisoning**
Incidence rates	1:6000 – 1:20000	1:25800 – 1:51700
Fatality rates	1:35000 (adults) 1:82000 – 1:200000 (children)	1:34474 – 1:103134

Diagnoses of exclusion are never entirely satisfactory, especially in this instance where there are many causes of postoperative liver dysfunction and this may explain some of the very variable figures quoted for the incidence. Moreover, we don't know what we don't know and the National Halothane

Study in the USA was not only a retrospective study with a dearth of postmortem information, but it was also conducted at a time when relatively little was known about the serology of viral hepatitis, especially post-transfusion hepatitis [30,37]. All that can be said is that, for the purpose of comparisons between the safety, or otherwise, of chloroform and halothane, the available data for the incidence and mortality rates for Type 2 Halothane Hepatitis and Delayed Chloroform Poisoning are of the same order of magnitude.

On the basis of the historical evidence we suggest that it is impossible to say whether chloroform might have been as safe as halothane if used in the same way. Nevertheless, like Hewer [22], we might speculate on what might have been. Davison specified criteria which he thought appropriate for inhalational anaesthesia in 1965. They included, *inter alia*,

> *"that it must be presupposed that the anaesthetist is competent, that use will be made of modern apparatus and techniques, and that, whether more sophisticated monitoring systems be employed or not, at least the blood pressure will be taken at frequent intervals…The patient must be properly prepared for operation…Anaesthesia should be conducted in the lightest plane which fulfils the surgeon's requirements …When spontaneous respiration is permitted it is always wise to employ an endotracheal catheter, and, when using nitrous oxide-chloroform mixture the concentration of oxygen should never be less than 30 per cent…" [33].*

After the introduction of halothane there remained several prominent advocates of chloroform, one of whom was Davison himself. He published anecdotal memories of his experiences of about 2400 cases in World War II, most of which involved using chloroform, and without a single death that could be attributed to anaesthesia. This could have been due to chance; however it is possible that many were done in the open air or in well ventilated tents in the Middle East and, in ambient outdoor air, when the concentrations of chloroform can be up to ten-fold lower than in indoor air [38]. This may also explain the good safety record of chloroform in nineteenth century India, especially that of Edward Lawrie who operated in Hyderabad in a theatre which was open to the air on three sides. [39,

40]. Such was Lawrie's faith in chloroform that, like Davison, he used it for induction, the very time at which it was most lethal [33]. By contrast Sykes argued that chloroform must never be used for induction because "according to history, no amount of skill, knowledge and experience, or even of accurate dose regulation can avoid primary cardiac failure in Occidental peoples" [11].

Davison was not impressed by precision vaporizers like the Chlorotec, arguing that what mattered was the effect produced on the patient. He therefore used "the standard Boyle vaporizer" and relied on clinical observation which cannot of course predict the sudden onset of ventricular fibrillation.

A more rational approach was taken by Dr HWC Griffiths of the Royal Edinburgh Infirmary, whose career was described to this Society in 2011 [41]. He theorised that if halothane, which was so similar to chloroform in many ways, could be administered safely using modern techniques, then why not chloroform also? He always used it exactly as others used halothane, as a supplement to nitrous oxide and 50 per cent oxygen, except that he administered chloroform via a Boyle's bottle vaporiser and not a Chlorotec even though he used a Fluotec vaporizer for halothane [42]. Endotracheal intubation was routine to ensure a clear airway and to permit rapid support of ventilation if required. He used chloroform uneventfully in this way until he retired.

Professor JP Payne, Research Professor of Anaesthesia at the Royal College of Surgeons of England, promoted the use of chloroform as a cheap volatile agent in financially poorer countries, provided that it was used following induction with thiopentone, together with an established airway and oxygen administration [43]. Because of its low cost, chloroform remained in widespread use in such countries for many decades. By 2002, and perhaps earlier, chloroform had been replaced on the W.H.O. List of Essential Medicines by halothane which still remains on the list in 2023. Payne also recognised that general practitioners in the United Kingdom at that time (1966) could be called upon to give emergency anaesthetics in difficult circumstances and, as "neither the roadside nor the railway siding or the [coal-]pit bottom were the place to learn new techniques; …in these

circumstances the use of open drop chloroform or halothane would not have been difficult to justify" [44].

Not everyone in a position of influence gave such sound advice as Griffiths and Payne. Wood-Smith, the senior author of the third edition of a textbook which was published in 1968 and which was popular with trainees, was a senior lecturer at the Royal Postgraduate Medical School for thirty years and a consultant anaesthetist at King's College Hospital [45]. In this book chloroform was recommended for both induction and maintenance, "given on an open mask or by means of the vaporizer on any anaesthetic machine in common use". Only later is it mentioned, almost in passing, that the Chlorotec vaporizer gives accurate vapour concentrations and that the dangers of induction are lessened if an intravenous barbiturate such as thiopentone is used for this purpose [46]. To end by quoting once more from Stanley Sykes who had written seven years earlier in 1961: "If chloroform is carelessly used, or even used carefully in the old manner, unnecessary deaths will again occur. This is absolutely certain….it may be that in the hands of the expert, it will be found to be safe, as it appears to be in the hands of Dr. Davison, but will it remain in the hands of the expert only" [11]? It would appear that even in the hands of some experts and therefore in the hands of those who read the experts' text books, it might not always have been used safely.

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Sir Ivan Magill

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This joint paper springs from the suggestion at the Association of Anaesthetists Heritage Committee by the first author that an English Heritage Blue Plaque should be sought for Sir Ivan Magill.

Ivan Whiteside Magill was born in Larne, Co. Antrim in Northern Ireland on 23 July 1888. His birthplace at 4 Barnhill Terrace, now 10 Curran Road, is marked by a plaque (Figure 1)

Figure 1. Plaque at the birthplace of Sir Ivan Magill

Educated at the Larne Grammar School, he became a medical student at Queen's University, Belfast. He was a keen sportsman, boxing and playing tennis and rugby. There is a well-known certificate to the effect that he had

administered one anaesthetic as a student although he said he had administered sixty. He qualified MB ChB BAO in April 1913 and moved to England. After a short spell in general practice in Leicester, he became House Surgeon and Resident Medical Officer (RMO) at the Stanley Hospital, Liverpool, and RMO at the Walton Hospital.

After the Great War broke out, Magill was appointed a Temporary Lieutenant in the Royal Army Medical Corps on 23rd April 1915, serving with the Irish Guards, and later at a field/ base hospital in Rouen. On 4th January 1916 while on leave, he married Edith Robinson in Belfast. She had qualified from Queen's, Belfast at the same time as him. He was gazetted Temporary Captain on 23rd April 1916 and relinquished his commission on 23rd April 1918. Many records of all of the armed services were destroyed in the Second World War including Magill's so it is impossible to find more details from the National Archives but it is more than likely that he administered anaesthetics.

It is understood that there was a Government Scheme for employment of Temporary Officers with qualifications and he was sent to Barnet War Hospital. He administered a few 'minor' anaesthetics there when he heard there was a demand for an anaesthetist at the Queen's Hospital for Facial and Jaw Injuries, Sidcup, Kent. At the time most hospital anaesthetics were administered by General Practitioners (GPs) on a sessional basis. They also expected to provide anaesthesia for private and paying patients in a nursing home or in the patient's house. Whereas GPs had sessions at Sidcup Hospital, Magill and Rowbotham were 'resident'. Magill said he chose Queen's because Edith was working as a school doctor for London County Council and he had seen 'Sidcup' on the back of a bus. In the 1921 Census, they are living at 26 Porchester Sq., Paddington, a lodging for young professionals and he is shown as based at Queen's Hospital Sidcup. In 1920, he and his wife, both submitted MD theses; hers was successful but his, on intra-tracheal anaesthesia, was rejected. In 1945, Queen's, Belfast made up for it by awarding him an honorary D. Sc.

Perhaps the first indication of a new era in anaesthesia was Stanley Rowbotham's paper in the British Medical Journal (BMJ) of 16th October 1920 describing anaesthesia by the nasal route for operations on the mouth and lips [1]. In it is described development of insufflation anaesthesia where

the patient's spontaneous ventilation was suppressed (apnoeic oxygenation). The unsatisfactory alternative was rectal oil-ether. Blind nasal 'intubation' is noted in the last paragraph of this paper, where Rowbotham describes passing a catheter through the nose and nasopharynx, catching it in the oropharynx with a special guiding rod and directing it into the trachea. He also used a second nasal catheter to prevent bubbling of blood in the surgical field and direct the vapours away from the surgeon who was also helped by packing of the pharynx. The paper has images of the catheters, guiding rod and a laryngoscope though Magill referred to the latter as a speculum. Two weeks later in the BMJ under 'Appliances and Preparations', Magill describes his well-known forceps (Figure 2). The forceps was advantageous over Rowbotham's guiding rod for placing the catheter into trachea; the forceps are still very much in use today. Both Rowbotham and Magill were anaesthetists at Sidcup and honorary anaesthetists in Greenwich Seamen's/Dreadnought hospital.

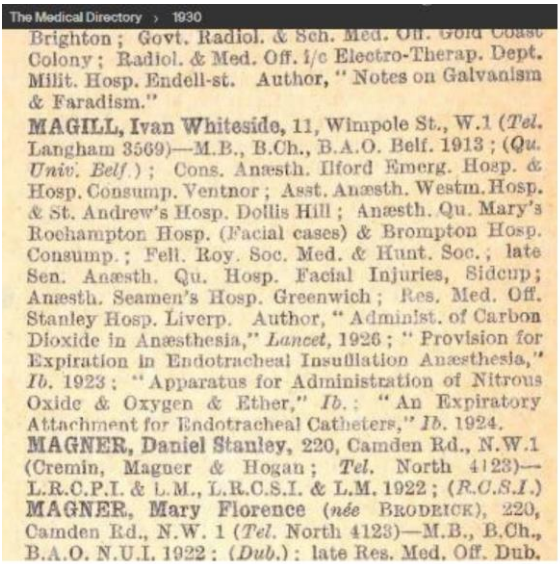
Figure 2. Magill forceps

Rowbotham and Magill's seminal paper, 'Anaesthetics in the Plastic Surgery of the Face and Jaws' [3] was presented at a meeting of the Anaesthetics Section of the Royal Society of Medicine (RSM) on 4th February 1921. by which time they had anaesthetised 3000 patients at the Queen's Hospital.

Shortly after this, Magill published under ‘New Inventions’ in The Lancet: ‘A portable apparatus for tracheal insufflation anaesthesia’made by Messrs Coxeter and Son [4]. This was important for his practice as he needed it to provide anaesthesia in a variety of places: nursing homes, patients’ houses and once for four hours in a bathroom at the Ritz hotel!

Magill and his wife moved to 14 Riding House Street, London W1, where they lived until 1928. His 1923 Medical Directory entry also describes him as ‘Sen. Anaesth. Qu. Hosp… Sidcup’. (Medical Directory entries are usually a year late).

Magill was appointed Honorary Anaesthetist to the Brompton Hospital (for Consumption/Tuberculosis) in 1923 and ‘Chloroformist’ at the Westminster Hospital in 1924. Over the next few years, he became the leading exponent of anaesthesia for the developing specialty of thoracic and cardiac surgery, devising endobronchial ways of isolating each lung. His 1930 Medical Directory entry shows appointments at six hospitals mainly in London but including one in Ventnor (Figure 3).


The Medical Directory › 1930

Brighton; Govt. Radiol. & Sch. Med. Off. Gold Coast Colony; Radiol. & Med. Off. i/c Electro-Therap. Dept. Milit. Hosp. Endell-st. Author, "Notes on Galvanism & Faradism."

MAGILL, Ivan Whiteside, 11, Wimpole St., W.1 (*Tel.* Langham 3569)—M.B., B.Ch., B.A.O. Belf. 1913; (*Qu. Univ. Belf.*); Cons. Anæsth. Ilford Emerg. Hosp. & Hosp. Consump. Ventnor; Asst. Anæsth. Westm. Hosp. & St. Andrew's Hosp. Dollis Hill; Anæsth. Qu. Mary's Roehampton Hosp. (Facial cases) & Brompton Hosp. Consump.; Fell. Roy. Soc. Med. & Hunt. Soc.; late Sen. Anæsth. Qu. Hosp. Facial Injuries, Sidcup; Anæsth. Seamen's Hosp. Greenwich; Res. Med. Off. Stanley Hosp. Liverp. Author, "Administ. of Carbon Dioxide in Anæsthesia," *Lancet*, 1926; "Provision for Expiration in Endotracheal Insufflation Anæsthesia," *Ib.* 1923; "Apparatus for Administration of Nitrous Oxide & Oxygen & Ether," *Ib.*; "An Expiratory Attachment for Endotracheal Catheters," *Ib.* 1924.

MAGNER, Daniel Stanley, 220, Camden Rd., N.W.1 (Cremin, Magner & Hogan; *Tel.* North 4123)—L.R.C.P.I. & L.M., L.R.C.S.I. & L.M. 1922; (*R.C.S.I.*)

MAGNER, Mary Florence (*née* BRODERICK), 220, Camden Rd., N.W. 1 (*Tel.* North 4123)—M.B., B.Ch., B.A.O. N.U.I. 1922; (*Dub.*): late Res. Med. Off. Dub.

Figure 3. Magill’s entry (highlighted) in the 1930 Medical Directory

By now Magill's address was 11 Wimpole Street, London, having moved there in 1928. Also noted are four papers in The Lancet, but not his November 1928 address to the Section of Anaesthetics, RSM: 'Endotracheal Anaesthesia.' where he describes the use of red rubber tubes larger than the catheters used before [5]. He also states that 'the routine use of endotracheal anaesthesia in teaching hospitals '...is detrimental to… anaesthetic knowledge of students who are likely to become General Practitioners (GPs) and provide routine general anaesthesia'.

There are a variety of stories about how he got the tubes but from Pallister's paper at the 1987 2nd International Symposium on the History of Anaesthesia [6], derived from Magill's 'Reminiscences', he went to a shop on the Tottenham Court Road which sold coils of rubber tubing for connecting cooking rings and Bunsen burners to the domestic gas supply. There he selected the ends of the coils which had a slightly firmer consistency, cutting the ends diagonally and bevelling with a soldering iron. He and Charles King had become good friends, a friendship based on a mutual admiration of each other's skills and the ability of King's manufacturing firm to make the great variety of equipment that Magill envisaged. When Magill told him that any tracheal tubes he left in hospitals for future use were stolen, King soon advertised 'Dr Magill's Special Intra Tracheal Tubes' at 9d each or 7/6 per dozen. Their unique partnership lasted more than 40 years and changed the specialty of anaesthesia.

Magill read a paper on 'Technique in Endotracheal Anaesthesia' at the BMA Meeting in Winnipeg [7]. This indicates that he had become established enough to be able to take time off to cross the Atlantic. Incidentally, he brought back 'Nembutal' from North America and used it intravenously as a basal narcotic.

Magill became Honorary Secretary of the Anaesthetics Section, RSM and in 1931 having long realised that the teaching of anaesthesia needed to be formalised, and the status of anaesthetists upgraded, he proposed a Diploma in Anaesthetics. However, he was told by the Secretary of the RSM that it was precluded by the Society's Charter and so fell by the wayside. He was involved in the founding of the Association of Anaesthetists on 1st July 1932 and in 1934, at a Council Meeting of the Association, he again proposed a

Diploma in Anaesthetics (DA). Magill was present at the subsequent discussions with the Conjoint Board of the Royal College of Physicians and the Royal College of Surgeons in London for creating the examination. The qualification of DA was introduced in 1935, establishing the world's first formal qualification in anaesthesia. Magill was an examiner for the first examination in November 1935. Following a long gestation, it ultimately led to the establishment of the Royal College of Anaesthetists.

In the 1939 National Register, he and Edith are shown as living at 66 Wimpole Street, London. Luckily, neither they nor their housekeeper were at home in 1941 when it was bombed. It was rebuilt in the 1950s which rules out that address for a blue plaque. Subsequently Magill's address in the Medical Register and the Medical Directory is given as his consulting rooms in Harley Street, London. However, Edith's address was 43 Wimpole Street from at least 1947 and it can be safely assumed that it is where they lived. That indicates an error in Edridge's obituary that he lived in Welbeck Street.

During the Second World War, Magill was an Adviser to the Emergency Medical Services in London and to the Armed Forces. Having been involved in the emergence of the National Health Service, he retired from his hospital appointments in 1955 but continued in private practice and administered his last anaesthetic aged 84. After Edith's death in 1973, he moved to Flat 14, 105 Hallam Street, London, close to the Royal Society of Medicine, which could be described as his spiritual home.

Magill received many honours; CVO followed by KCVO for anaesthetising several members of the Royal Family but almost equally, perhaps more importantly, numerous awards and honours from anaesthetic (and surgical) organisations, both at home and worldwide.

Magill was a strong but dextrous man with a liking for food and drink, and strong Burma cheroots, a habit picked up in the Great War. He had a lively sense of humour and liked practical jokes often diverting an observer's attention as he passed a nasal tube blindly. On his 97th birthday he caught a five pound trout fishing at the Houghton Club stretch of the River Test. He had been a member since 1932 of that renowned and exclusive club.

Magill died in his 99th year in Bristol at Lakeside House, Leigh Woods, the home of his nephew (son of his sister Sara), Campbell Laird.

Magill was the most influential figure in the 20th century in the development of the speciality of anaesthesia perhaps only rivalled by Ralph Waters. A visionary, who realised that the teaching of anaesthesia both for undergraduates and postgraduates needed to be improved and that higher standards and formal examinations were needed, to raise the status of anaesthesia. He was also an innovator and pioneer, developing techniques and instruments now taken for granted. The equipment designed by Magill includes his 'attachment', forceps, laryngoscopes, and endotracheal tubes.

In June 2023, the Anaesthesia Heritage Centre submitted an application to English Heritage for a blue plaque for Sir Ivan Magill. The proposed location for the plaque is 43 Wimpole Street, Marylebone, London where he lived in the 1950s.

Unfortunately, even before the COVID-19 pandemic, there was already a backlog of applications awaiting consideration. This means that it is likely to be at least a year until the application is taken forward to the Blue Plaque Panel. It should also be noted that the award of a blue plaque is a highly competitive and selective process, and only around a fifth of suggestions received make the shortlist.

The Blue Plaque scheme was established by the Society of Arts (now the Royal Society of Arts) in 1866 but has been run by English Heritage since 1986. The first plaque erected was to Lord Byron in 1867. There are now around 950 plaques in London. Interestingly, the City of London is excluded from the scheme, their plaque scheme is run by the Corporation of London.

The plaques are made from ceramic slipware. Some early versions were terracotta and even green or grey in colour, some were made from bronze or lead, and shapes other than circles were used too.

The Blue Plaque scheme is a way to memorialise someone irrespective of their social standing, occupation or when a person died. The names and reason for fame are inscribed on a plaque of identical design. The scheme itself also belongs to everyone as anyone can propose anybody.

As of the 6 September 2023, the government has formalised plans for the expansion of the official Blue Plaque scheme from London to England. The plan will see the Department of Culture, Media and Sport, Historic England, and English Heritage work together to develop the England-wide scheme.

References

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2. Magill IW. Forceps for Intratracheal Anaesthesia. *British Medical Journal* 1920; **ii**: 670.
3. Rowbotham ES, Magill I. Anaesthetics in the Plastic Surgery of the Face and Jaws. *Proceedings of the Royal Society of Medicine* 1921; **14:** 17-27.
4. Magill IW. A portable apparatus for tracheal insufflation anaesthesia. *Lancet* 1921; **1**: 918.
5. Magill IW. Endotracheal Anaesthesia. *Proceedings of the Royal Society of Medicine* 1928; **22**: 83-8.
6. *The History of Anaesthesia* . Eds Atkinson RS and Boulton TB, London, Royal Society of Medicine Services; 1988; pp 605-9.
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A brief history of Llandudno

Mr Rhodri Clark
Guest Lecture

The Guest Lecture is not published. Below is a brief background to Mr Clark:

Rhodri Clark is a freelance journalist in North Wales and a former correspondent for the Western Mail, the national newspaper of Wales.

Rhodri Clark co-founded the History Points initiative in 2012; this uses QR codes at places of interest to present on-the-spot historical information about each featured place or object. The project began in Conwy and Llandudno and now covers more than 2,200 places across Wales. Each location has a page on the HistoryPoints.org website, which anyone can browse at home. The QR code linked to each web page enables people to stumble across interesting stories and/or satisfy their curiosity about objects and places they see.