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The genesis of anaesthesia in prehistory

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The history of anaesthesia may be divided into two periods:

I — ancient and medieval times, called the "pre-anaesthetic" or "primitive anaesthesia" period when there were no anaesthetics, only intoxicating agents. The period lasted from ancient times until October 16, 1846.

II — the modern period since 1846, when William Thomas Morton demonstrated that ether could alleviate the pain of surgical operations.

Although surgical anaesthesia was not known in ancient and medieval times, the issue of pain relief in surgical patients was of interest. The term anaesthesia was already known (from Greek *anaisthétos*, meaning "without sensation", "absence of emotions" "insensibility") and was first used by Plato in 400 BC [1, 2].

In ancient and medieval times, pain was relieved with chemical agents, e.g. herbal extracts (in the form of infusions) and alcohol (mainly wine) [3]. The first historical fact in this regard can be found in Babylonian tablets (about 2500 BC), describing the way to prepare a cement containing henbane (*Hyoscyamus niger*) for the painless filling of carious defects [4].

From 2000 BC and the initial centuries of the Christian era, the use of mandrake root extracts for painful wounds, which was recommended by Hippocrates (460 BC), Cornelius Celsius (about 35 BC), Galen (about 120AD) and Avicenna (980 AD).

Chinese physicians (4th and 3rd centuries BC) used Indian hemp extracts while in ancient Egypt, poppy extracts were applied. In *The Odyssey*, Homer called opium the juice of oblivion. One should note that already in the 8th century BC, a Poppy Goddess was being depicted on Crete.

About 1200 AD, *Ugo de'* Borgognoni da *Lucca* (an expert medical doctor based in Bologna) prepared cocktails containing opium, mulberry, jimsonweed, Indian hemp and mandrake and soaked sponges with them ("sleeping sponges"), which he placed below the patient`s nose (the first "anaesthetising tools").

Opium, a wonderful analgesic and anaesthetic agent, was called laudanum by Paracelsus (1493-1541), that is "something to be praised", and was used in the form of inhalation powders, tablets or in combination with alcohol (Fig. 1).

Moreover, pain was relieved with physical methods. In 1050 AD patients were immersed in bathtubs with cold water (pre-history of hypothermia), covered with ice, placed on snow or had quickly evaporating substances poured all over them (e.g. ether and chloroform). Additionally, attempts were made to exert pressure on the nerve trunks (Ambroise Paré, 1509–1590; and Benjamin Bell, 1749-1806). The methods of cooling patients and nerve compressions were those applied for the longest period of time as they were most rational [6]. Furthermore, psychological measures to affect

Figure 1. Phillippus Aureolus Theophrastus Bombastus von Hohenheim Paracelsus (1493–1541) [5]

pain were attempted. The practices of Franz Anton Mesmer, who developed mesmerism (1766), are well known. Putting patients into a trance was supposed to render them insensitive to pain. In 1784, however, this practice was prohibited.

All the agents and methods mentioned above were poorly effective and often caused death due to overdosing. The methods of precise dosing and determining the amount of active substances in preparations were not known [7]. However, the general attitudes of individuals in the Middle Ages are worth stressing. Medieval philosophy advocated the acceptance of pain as a kind of punishment for sins and a sign of bravery.

During this period, surgery was considered a craft. Surgeons had to be confident and self-controlled while using a knife, despite the pain and screams of their patients. The rule of quick surgery was obeyed (thigh enucleation: 40 seconds, limb amputation: several seconds). Fainting was expected both by patients and physicians; moreover, massive bloodlettings were performed before surgery [8].

Two examples may illustrate the resilience to pain of medieval patients. The first concerns Prince Dedo of Saxony, who wanted to accompany King Henry VIII to Italy and underwent the cosmetic removal of excess fat (he could not mount a horse). He died several hours after the procedure. The second example concerns Prince Leopold V who sustained a complicated crural fracture. He was treated with ointments and dressings; unfortunately, gangrene set in and he ordered his servant to amputate his limb with an axe without anaesthesia; the following day, he died [9].

The beginnings of inhalation anaesthesia go back to 1272, when the first reports about an intoxicating substance ("sweet oil of vitriol") discovered by Raimondus Lullus can be found. In the 15th century, the above-mentioned Paracelsus observed that chickens fed with grains soaked in vitriol oil fell asleep. In the same period, Valerius Cordus, a German botanist and chemist, also discovered vitriol oil. In 1730, Frobenius, a London apothecary, confirmed the sleep-inducing properties of the oil and called it ether oil. However, the agent was not used in humans [10].

In 1776, Joseph Priestley (an English chemist) discovered nitrous oxide (N_2O), which was also independently discovered by Scheele, a Swedish apothecary. Humphrey Davy (a chemist) used this agent as an analgesic for his headaches and toothaches. He called it "laughing gas". In 1844, Horace Wells, a dentist, extracted a tooth under N_2O; the next attempt of using N_2O conducted in Boston in front of numerous witnesses failed and Wells was ridiculed [11].

In 1839, Alfred Velpeau, a famous French surgeon, presented his opinion on surgical pain in the sentence *Éviter la douleur dans la chirurgie est une chimêre, qu'elle n'est plus permie de poursuivre aujourd'hui* (Avoidance of pain in surgery is an illusion that cannot be succumbed to). A similar opinion was presented by Seweryn Gałązkowski (a Vilnius surgeon). Fortunately, they were both wrong [12].

Figure 2. William Morton [13]

In January 1842, William E. Clarke used ether during a tooth extraction in New York. Three months later, Crawford Long, an American surgeon, anaesthetised the patient undergoing the removal of a sebaceous cyst on the neck by putting a handkerchief soaked in ether over his nose and mouth. However, these facts were not published.

The beginnings of professional anaesthesia are associated with the experiments carried out by Charles Jackson (a physician, chemist and geologist from Boston) in the years 1841–1842. He and William Morton (his student and also a dentist) inhaled a mixture of ether and air.

On October 16, 1846, ether was used for the first time at a public demonstration for removing a maxillary tumour; the procedure was performed by John Collins Warren on a young printer Gilbert Abbot in a Boston Hospital. Morton attracted attention of the papers and received the prize money in 1853, which led to a conflict between the scientists [13] (Fig. 2).

The fate of the first anaesthetists was tragic. Horace Wells, who could not accept that some other people had gained recognition, became addicted to chloroform and committed suicide by cutting open an artery in 1848. William Morton, despite the prize money he had received earlier, died in poverty in New York due to alcohol addiction, while Charles Jackson descended into madness and died at the age of 75 years in a psychiatric hospital in 1880 [7].

In 1831, chloroform was discovered, while in 1847, James Simpson, a surgeon and an obstetrician from Edinburgh, first used the vapours of chloroform on himself and then for anaesthetising women during labour.

Figure 3. Francis Hoeffer McMechan ([21], image courtesy of Wood Library Museum of Anesthesiology, Parkridge, Il)

John Snow (1813–1858), a London physician dealing exclusively with anaesthesiology, anaesthetised Queen Victoria with chloroform during two deliveries. Chloroform became a strong competitor of ether, with the technique of its use being extremely simple [14].

Due to the high toxicity of chloroform, confirmed later, it subsequently disappeared from operating rooms (in the early 20th century) [15, 16].

Already by the Middle Ages, inhalational agents had been used for recreation (paintings in Australian and Mexican Caves, Greek and Persian writings), and news about such properties of nitrous oxide and chloroform spread rapidly, especially among the upper classes. In the mid-19th century, parties with chloroform and nitrous oxide became fashionable, even special taverns were opened. Nitrous oxide was sold at parties organised by students of medicine, during popular music concerts (the gas being placed in special balloons) [17].

At the beginning of the 19th century, several anaesthetics were available, although the methods of administration and dosing were not fully known. Anaesthetics revolutionised surgery and the beliefs that pain had to accompany each surgical procedure were overcome. Successful reports regarding painless surgeries spread first in Europe and then worldwide; a new era of anaesthesia had begun [18, 19].

The words of Mieczysław Wyględowski, a surgeon, are noteworthy; he stressed the role of human dreams in anaesthesia (e.g. a futuristic vision of Icarus — planes and the conquest of space). In his book, he writes: "if it weren't for the 'dream' of drugs relieving pain, inducing sleep and enabling painless surgical procedures, modern medicine would be in the Dark Ages, despite the vast technological advances in innovative drugs" [20].

Francis Hoeffer McMechan, a famous anaesthesiologist living at the turn of the 19th and 20th centuries, dreamed about a global, worldwide society of anaesthesiologists. Although he was severely ill and did not live to witness the accomplishment of his vision, it eventually came true with the foundation of the World Federation of Societies of Anaesthesiologists in 1955 [21, 22] (Fig. 3).

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Polish pioneers of local anaesthesia

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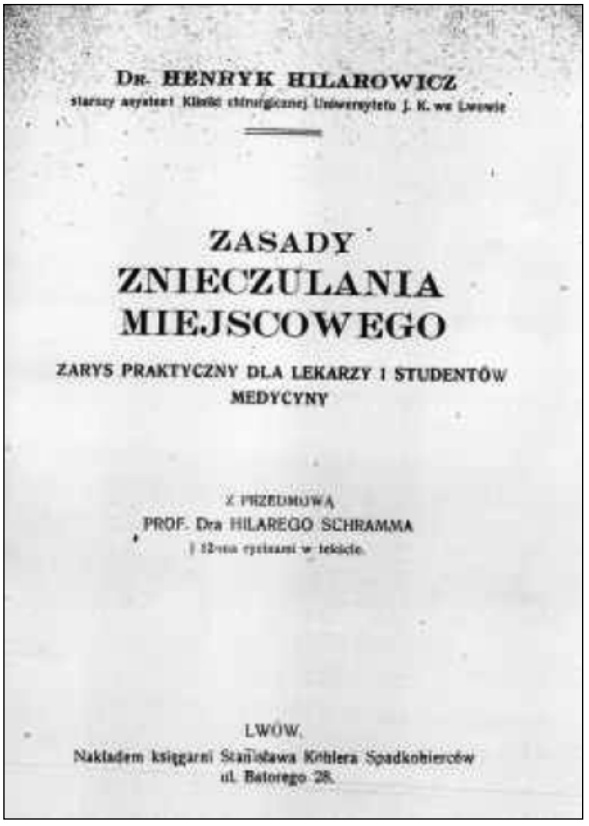
The scientific discovery of general anaesthesia is regarded as a breakthrough in the advancement of medical science. On October 16, 1846 Thomas W. Morton performed the first preoperative "ether anaesthesia", the operating surgeon being Mr. John Collins Warren, Professor of Surgery at Harvard. Nevertheless, forty years had to go by before an ophthalmologist from Trieste, Dr Josef Brettauer, presented the results of a study on the superficial/topical application of cocaine solution for preoperative anaesthesia of the eye conducted by his colleague, Dr Karl Koller (1857–1944), at a congress of German Ophthalmologists in Heidelberg on August 15, 1884 (Koller was financially strapped and could not afford to take part in the congress in person) [1].

This date is considered to have given rise to the era of local anaesthesia which, from then on, was widely employed, most often in ophthalmology and laryngology, since the superficial/topical administration of an anaesthetic agent, namely cocaine, limited the area of anaesthesia to the mucous membranes or conjunctiva. However, the first studies on the use of the infiltration technique in local anaesthesia were conducted four years later by Seweryn Perkowski (1845–1907), a Polish medical doctor, working at the Ujazdowski Hospital in Warsaw at that time, with the results of his study being published in the medical journal "Medycyna" (*Medicine)* in 1888 [2–4]. In his article entitled "On local anaesthesia and local anaesthetic agents," Seweryn Perkowski wrote: "I tested the action of sterile water which I injected subcutaneously and it turned out that these injections work perfectly well to relieve rheumatic pain" [2]. The results of these studies prove that this Polish medical doctor was the actual precursor of the infiltration technique in anaesthesia. Unfortunately, as Perkowski published his study results in a local Polish journal, a German surgeon, Dr. Karol Ludwik Schleich (1859–1922), who presented his anaesthetic technique 6 years later at a congress of German Surgeons in Berlin, is considered to be the inventor of the anaesthetic infiltration technique. Schleich conducted his study on a group of 3,000 patients (among other agents he also used cocaine) and was probably unfamiliar with Perkowski`s study results. Interestingly, however, Schleich emphasised that he had launched his studies on the infiltration technique in anaesthesia in 1890 after having been inspired by a discussion he had had at the Black Piglet Inn in Berlin with his friend, Stanisław Przybyszewski (1868–1927), then a medical student who later became an accomplished poet and playwright of the Young Poland movement [3–5]. The discussion, which focused on the analysis of the physiology of the nervous system and possibilities of its modulation, was conducted on the basis of very precise pictures presenting the nerve structures drawn by Przybyszewski himself. Both gentlemen inferred that the injection of sterile water into the tissue, by exerting pressure onto the nerve structures, may impair the nerves' ability to conduct sensory impulses [4, 6]. Karol Ludwik Schleich also emphasised that: "to me, Stanisław Przybyszewski, with his argumentation and drawings, was the spark igniting the fuel of scientific inspiration for my taking up studies on infiltration anaesthesia" [3].

During the time of the dynamic development of local anaesthesia techniques, Polish doctors also conducted studies on the application of these methods. In 1898, at a congress of Polish Surgeons in Cracow, Prof. Rudolf Trzebicky (1859–1903) and Dr Hilary Schramm (1857–1940) from the Surgical Clinic of the Jagiellonian University run by Prof. Rudolf Rydygier (1850–1920), presented the results of a study entitled "On the use of cocaine in local anaesthesia". Moreover, in 1901, at the 30th Congress of German Surgeons in Berlin, Prof. Jan Mikulicz-Radecki (1850–1905) delivered a talk entitled "On local anaesthesia and local anaesthetic agents" in which he presented 40 cases of subarachnoid anaesthesia.

In the newly independent Poland, i.e. after 1918, the contribution of Polish scientists to the development of anaesthesia was equally dynamic. Doctors working under Prof.

Figure 1. Henryk Hilarowicz (in military uniform; below, sitting — Ryszard Rodziński) [7]


Dr. HENRYK HILAROWICZ

starszy asystent Kliniki chirurgicznej Uniwersytetu J. K. we Lwowie

ZASADY
ZNIECZULANIA
MIEJSCOWEGO

ZARYS PRAKTYCZNY DLA LEKARZY I STUDENTÓW MEDYCYNY

Z PRZEDMOWĄ
PROF. Dra HILAREGO SCHRAMMA
[12-ma rycinami w tekście.

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Nakładem księgarni Stanisława Kohlera Spadkobierców
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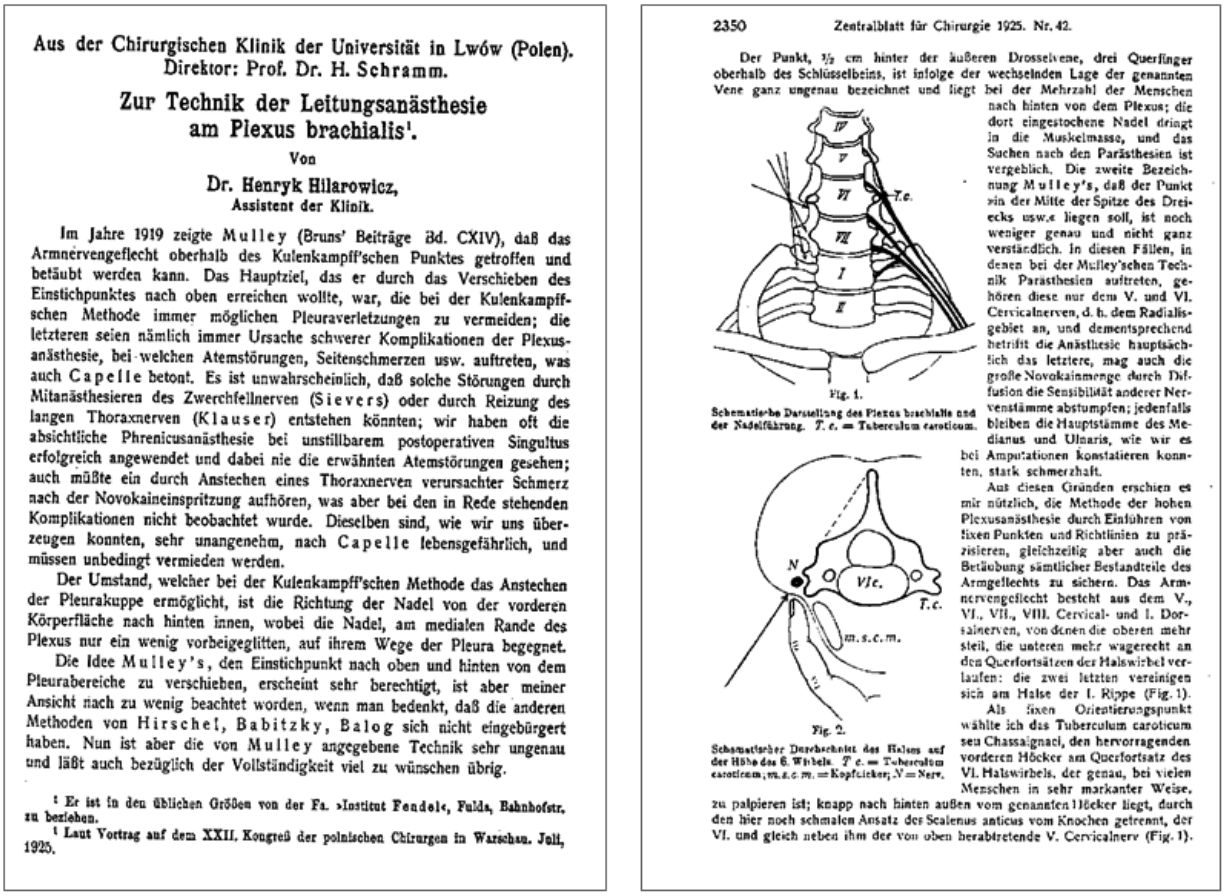
Figure 2. The first Polish handbook on conduction anaesthesia entitled: *The Principles of Local Anaesthesia* (published by St. Koblen & Co., Lviv, 1924)

Hilary Schramm (who took over the clinic from Prof. Rudolf Rydygier in 1920) at Jan Kazimierz Clinic of Surgery in Lviv had remarkable achievements in this field. Both a broad scientific interest, far beyond the issues of surgery, and the excellent scientific atmosphere created by Prof. Schramm resulted in the foundation of the Polish School of Regional Anaesthesia in Lviv with Prof. Henryk Hilarowicz and Dr Ryszard Rodziński as its leading members (Fig. 1).

Henryk Hilarowicz was born in Warsaw in 1880. He moved to Lviv at the age of 12 when his father, Prof. Józef Nusbaum-Hilarowicz, an accomplished zoologist and evolutionist, was offered a post at the Faculty of Zoology and Comparative Anatomy at Jan Kazimierz University in Lviv. Young Henryk soaked up the academic atmosphere and inherited the enthusiasm for scientific work from his father. He studied medicine at the Faculty of Medicine at Lviv University, where in 1914 he was conferred with a Doctor of Medical Science degree. During World War I, he was a military doctor in the Austrian army. He showed his patriotism and courage during the Defence of Lviv against Ukrainian nationalists in 1918, serving as a doctor in the 3rd Air Group. Right after the war, he started working at the gynaecological-obstetrics clinic in Lviv. In 1921, he became an assistant at the Clinic of Surgery at Lviv University under Prof. Schramm who created an excellent scientific atmosphere encouraging his associates to broaden and update their knowledge, travel abroad, publish articles and deliver papers at scientific congresses. At the Lviv Clinic, Dr Hilarowicz, together with Dr Ryszard Rodziński worked on the optimisation and implementation of new methods of local anaesthesia. Dr Hilarowicz was promoted to professor in 1927, becoming a fellow of the International Society of Surgeons in Brussels in 1929. On the recommendation of Prof. Tadeusz Ostrowski, he was awarded the title of associate professor in surgery at Jan Kazimierz University in Lviv. Hilarowicz was the author of numerous papers on conduction anaesthesia and abdominal cavity surgery. In 1924, St. Koblen & Co. published the first Polish handbook on the techniques of conduction anaesthesia, entitled *The Principles of Local Anaesthesia* (Fig. 2), while in 1925 Książnica Atlas published another handbook of his entitled *First Aid in Emergencies*.

In 1922, in Issue 47 of the *Polish Medical Newspaper*, Henryk Hilarowicz published an article entitled "On the issue



Aus der Chirurgischen Klinik der Universität in Lwów (Polen).
Direktor: Prof. Dr. H. Schramm.

Zur Technik der Leitungsanästhesie am Plexus brachialis[1].

Von

Dr. Henryk Hilarowicz,
Assistent der Klinik.

Im Jahre 1919 zeigte Mulley (Bruns' Beiträge Bd. CXIV), daß das Armnervengeflecht oberhalb des Kulenkampff'schen Punktes getroffen und betäubt werden kann. Das Hauptziel, das er durch das Verschieben des Einstichpunktes nach oben erreichen wollte, war, die bei der Kulenkampff-schen Methode immer möglichen Pleuraverletzungen zu vermeiden; die letzteren seien nämlich immer Ursache schwerer Komplikationen der Plexusanästhesie, bei welchen Atemstörungen, Seitenschmerzen usw. auftreten, was auch Capelle betont. Es ist unwahrscheinlich, daß solche Störungen durch Mitanästhesieren des Zwerchfellnerven (Sievers) oder durch Reizung des langen Thoraxnerven (Klauser) entstehen könnten; wir haben oft die absichtliche Phrenicusanästhesie bei unstillbarem postoperativen Singultus erfolgreich angewendet und dabei nie die erwähnten Atemstörungen gesehen; auch müßte ein durch Anstechen eines Thoraxnerven verursachter Schmerz nach der Novokaineinspritzung aufhören, was aber bei den in Rede stehenden Komplikationen nicht beobachtet wurde. Dieselben sind, wie wir uns überzeugen konnten, sehr unangenehm, nach Capelle lebensgefährlich, und müssen unbedingt vermieden werden.

Der Umstand, welcher bei der Kulenkampff'schen Methode das Anstechen der Pleurakuppe ermöglicht, ist die Richtung der Nadel von der vorderen Körperfläche nach hinten innen, wobei die Nadel, am medialen Rande des Plexus nur ein wenig vorbeigeglitten, auf ihrem Wege der Pleura begegnet.

Die Idee Mulley's, den Einstichpunkt nach oben und hinten von dem Pleurabereiche zu verschieben, erscheint sehr berechtigt, ist aber meiner Ansicht nach zu wenig beachtet worden, wenn man bedenkt, daß die anderen Methoden von Hirschel, Babitzky, Balog sich nicht eingebürgert haben. Nun ist aber die von Mulley angegebene Technik sehr ungenau und läßt auch bezüglich der Vollständigkeit viel zu wünschen übrig.

[1] Er ist in den üblichen Größen von der Fa. »Institut Fendel«, Fulda, Bahnhofstr. zu beziehen.

[1] Laut Vortrag auf dem XXII. Kongreß der polnischen Chirurgen in Warschau. Juli, 1925.

Der Punkt, ½ cm hinter der äußeren Drosselvene, drei Querfinger oberhalb des Schlüsselbeins, ist infolge der wechselnden Lage der genannten Vene ganz ungenau bezeichnet und liegt bei der Mehrzahl der Menschen nach hinten von dem Plexus; die dort eingestochene Nadel dringt in die Muskelmasse, und das Suchen nach den Parästhesien ist vergeblich. Die zweite Bezeichnung Mulley's, daß der Punkt »in der Mitte der Spitze des Dreiecks usw.« liegen soll, ist noch weniger genau und nicht ganz verständlich. In diesen Fällen, in denen bei der Mulley'schen Technik Parasthesien auftreten, gehören diese nur dem V. und VI. Cervicalnerven, d. h. dem Radialisgebiet an, und dementsprechend betrifft die Anästhesie hauptsächlich das letztere, mag auch die große Novokainmenge durch Diffusion die Sensibilität anderer Nervenstämme abstumpfen; jedenfalls bleiben die Hauptstämme des Medianus und Ulnaris, wie wir es bei Amputationen konstatieren konnten, stark schmerzhaft.

Fig. 1.

Schematische Darstellung des Plexus brachialis und der Nadelführung. T. c. = Tuberculum caroticum.

Aus diesen Gründen erschien es mir nützlich, die Methode der hohen Plexusanästhesie durch Einführen von fixen Punkten und Richtlinien zu präzisieren, gleichzeitig aber auch die Betäubung sämtlicher Bestandteile des Armgeflechts zu sichern. Das Armnervengeflecht besteht aus dem V., VI., VII., VIII. Cervical- und I. Dorsalnerven, von denen die oberen mehr steil, die unteren mehr wagerecht an den Querfortsätzen der Halswirbel verlaufen: die zwei letzten vereinigen sich am Halse der I. Rippe (Fig. 1).

Als fixen Orientierungspunkt wählte ich das Tuberculum caroticum seu Chassaignaci, den hervorragenden vorderen Höcker am Querfortsatz des VI. Halswirbels, der genau, bei vielen Menschen in sehr markanter Weise, zu palpieren ist; knapp nach hinten außen vom genannten Höcker liegt, durch den hier noch schmalen Ansatz des Scalenus anticus vom Knochen getrennt, der VI. und gleich neben ihm der von oben herabtretende V. Cervicalnerv (Fig. 1).

Fig. 2.

Schematischer Durchschnitt des Halses auf der Höhe des 6. Wirbels. T. c. = Tuberculum caroticum; m. s. c. m. = Kopfnicker; N = Nerv.

Figure 3. Hilarowicz H. Zur Technik der Leitunganästhesie am Plexus Brachialis. Zentralblatt für Chirurgie 1925; 42: 2349–2351) [8]

of the second branch of the trigeminal nerve anaesthesia", while the following year his paper entitled: "Practical remarks on techniques and certain modes of local anaesthesia" was published in Issue 27 of the *Polish Medical Newspaper* (PGL). Hilarowicz`s book *On the Failures and Hazards of Some Techniques of Local Anaesthesia* was published in Issue 1 of the *Polish Medical Newspaper* in 1927 while his papers were also published abroad. Two of his articles on local anaesthesia, namely: "Zur Technik der Leitunganästhesie am Plexus Brachialis" from 1925, and "Zur Frage der Lokalanästhesie bei Magenoperationen" from 1927 appeared in Issues 42 and 54 of *Zentralblatt für Chirurgie*, respectively.

Henryk Hilarowicz deserves a special place in the history of anaesthesia for being a pioneer in the field of local anaesthesia. He was the first doctor in the world to demonstrate anaesthesia of the brachial plexus with the access via the scalene muscles. A description of this method was published in *Zentralblatt für Chirurgie* in 1925 [8] (Fig. 3).

Since this technique was described by Hilarowicz 45 years prior to the publication of A.P. Winnie's [9], I will take the liberty of citing the words of the author: "….I chose the anterior tubercle of the transverse process of the sixth cervical vertebra, known as the Chassaignac tubercle, as the stay landmark. The cervical tubercle separates the anterior scalene muscular band, still narrow at this altitude, from the fifth and sixth cervical nerves. The technique of anaesthesia is as follows: in the supine position, the head is tilted strongly backwards and turned in the opposite direction, with the index finger of the left hand we palpate the anterior-lateral surface of the vertebral column alongside the posterior dorsal part of the sterno-cleidomastoid muscle which we strongly push away towards the midline. The row of anterior tubercles of the lateral processes of the vertebral column terminates roughly three fingers above the point of division of the clavicle into the medial and internal third part. The Chassaignac tubercle is the more protruding point in question. Slightly externally and below the cervical tubercle, a narrow band of tense anterior scalene muscle and the crevice separating it from the muscle situated posteriorly may be felt, especially in thin patients. This is exactly where the brachial plexus nerves should be looked for. Marking the cervical tubercle with the pulp of the index finger of the left hand, we choose the injection site to be roughly 5 mm externally and 5 mm below the cervical tubercle, with the right hand we make a puncture with a thin needle, about 8 mm-long with no syringe attached and we aim directly at

the spinous process of the sixth cervical vertebra, or a little anteriorly in relation to it. At the depth of about 1 cm, we cause, immediately or after a while, a tingling sensation resulting from the contact of the needle with the fifth and sixth cervical nerves mainly in the posterior part of the shoulder and in the region of the bifurcation of the radial nerve, i.e. as patients usually report, in the thumb. At this localisation of the needle, we inject 5 mL of 2% novocaine solution with adrenal gland extract….."

Henryk Hilarewicz was a surgeon and the author of approximately 100 publications, mainly on gastrointestinal tract surgery and surgical methods concerning arterial hypertension treatment. However, the special place that he deserves in the history of medicine is connected with the development of local anaesthesia since he was the first doctor to describe the technique of brachial plexus anaesthesia with access via the scalene muscles. After Poland had lost its independence in 1939 and during the Soviet occupation of Lviv, Prof. Hilarowicz was the head of the surgical ward of the Military Hospital No. 604 located in Lviv. In July 1941, Lviv was captured by the German army. On July 4, 1941, during the early hours of the morning, he was taken from his home by German SS officers and, on the very same night,he and other Polish professors from Lviv universities were brutally murdered on the Wulecki Heights [10].

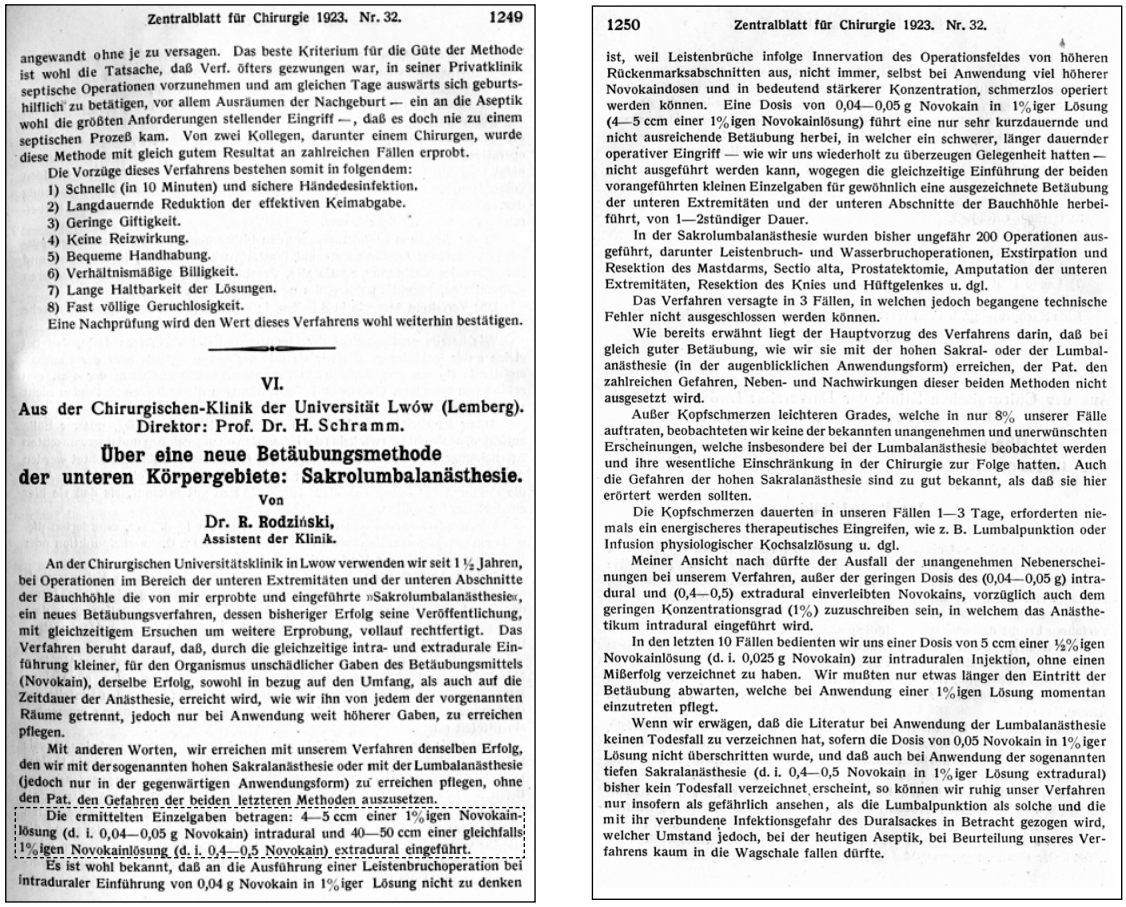
Ryszard Rodziński was born in Split in Dalmatia in 1890. His father was a military doctor, Herman Józef Rodziński, while his mother's maiden name was Wiszniewska. Ryszard`s father, having finished his medical studies at the University of Vienna, joined the Austro-Hungarian Army in 1887 and, after Poland had won its independence, he became a military doctor in the Polish Army where he was promoted to Brigadier General. After graduating from secondary school, Ryszard Rodziński studied medicine at Lviv University, where shortly before the outbreak of the First World War, he earned the academic degree of Doctor of Medical Science. After the completion of his studies, he started his professional and scientific career at the Clinic of Surgery at Lviv University where he spent 12 years of his life. He worked as an assistant with distinguished professors of surgery, first with Ludwik Rydygier and later with Hilary Schramm. In 1926, Ryszard Rodziński took up an independent post of Head of the Paediatric Surgery Department in St. Sophia's Paediatric Hospital, while in 1936, he became the head of the largest 200-bed surgery department in the National Public Hospital in Lviv [11].

In Ryszard Rodziński's time at the Lviv Clinic of Surgery two central blocking techniques were known and routinely used, namely lumbar anaesthesia, which was literally subarachnoid anaesthesia, and so-called sacral anaesthesia (namely epidural anaesthesia via the sacral region). Unfortunately, administration of these types of anaesthesia carried the risk of complications and even death, with the percentage of both being high. Such complications mainly resulted from the necessity of administering high doses and volumes of local anaesthetic agent.

Ryszard Rodziński conducted in-depth research into the mechanisms of adverse reactions and post-anaesthetic spinal cord injury complications. In order to evaluate the changes in intracranial pressure after the administration of increasing volumes of epidurally introduced anaesthetic fluid, he initially performed his studies on dogs and cadavers. Later, his experimental studies were transferred into clinical surroundings where Rodziński measured, among other things, the cerebrospinal fluid pressure in the lumbar segment of the vertebral column after the administration of different volumes (from 10 to 7 mL) of 0.9% NaCl or 1% procaine solution via the sacral access in patients undergoing urological procedures [12].

Searching for a safe local anaesthetic for abdominal area operations, Rodziński was the first scientist in the world to show interest in combining both types of anaesthesia applied to the region of the spinal cord (spinal epidural anaesthesia). He performed the procedure in the following sequence: with the patient turned into the left lateral position he conducted epidural anaesthesia via the sacral access using 30–40 mL of 1% procaine, while next, also via the sacral access, he administered 4 mL of 1% procaine with adrenalin into the subarachnoid space. In order to perform subarachnoid anaesthesia, Rodziński recommended that a needle as thin as possible should be used, aptly associating the rate of post-anaesthetic headaches with the gauge of the needle. This type of anaesthesia, labelled by Rodziński as "sacral lumbar", was, according to the current nomenclature, a combined subarachnoid epidural anaesthesia (combined spinal-epidural analgesia) and was used not only in surgery but also in gynaecology, obstetrics and urology. In July 1922, in his report entitled "On combined subarachnoid-epidural anaesthesia", which was delivered at the 19th Congress of Polish Surgeons in Warsaw, Rodziński gave an account of his scientific experience gained from the use of combined subarachnoid-epidural anaesthesia for gynaecological, urinary and surgical operative procedures and emphasised the method`s efficacy and safety, due to a possible reduction of the necessary procaine dose, without compromising the quality of anaesthesia. The same findings were also described in the articles published in the Polish Medical Journal in 1923 [13], as well as in *Zentralblatt für Chirurgie* [14], the main surgical journal of German-language regions. All this gave him a prestigious place in the pantheon of pioneers of local anaesthesia (ryc. 4).

Unfortunately, serious health problems, a congenital heart defect, as well as tuberculosis, got in the way and



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angewandt ohne je zu versagen. Das beste Kriterium für die Güte der Methode ist wohl die Tatsache, daß Verf. öfters gezwungen war, in seiner Privatklinik septische Operationen vorzunehmen und am gleichen Tage auswärts sich geburtshilflich zu betätigen, vor allem Ausräumen der Nachgeburt — ein an die Aseptik wohl die größten Anforderungen stellender Eingriff —, daß es doch nie zu einem septischen Prozeß kam. Von zwei Kollegen, darunter einem Chirurgen, wurde diese Methode mit gleich gutem Resultat an zahlreichen Fällen erprobt.

Die Vorzüge dieses Verfahrens bestehen somit in folgendem:

1) Schnelle (in 10 Minuten) und sichere Händedesinfektion.
2) Langdauernde Reduktion der effektiven Keimabgabe.
3) Geringe Giftigkeit.
4) Keine Reizwirkung.
5) Bequeme Handhabung.
6) Verhältnismäßige Billigkeit.
7) Lange Haltbarkeit der Lösungen.
8) Fast völlige Geruchlosigkeit.

Eine Nachprüfung wird den Wert dieses Verfahrens wohl weiterhin bestätigen.

VI.

Aus der Chirurgischen-Klinik der Universität Lwów (Lemberg).
Direktor: Prof. Dr. H. Schramm.

Über eine neue Betäubungsmethode der unteren Körpergebiete: Sakrolumbalanästhesie.

Von

Dr. R. Rodziński,
Assistent der Klinik.

An der Chirurgischen Universitätsklinik in Lwow verwenden wir seit 1½ Jahren, bei Operationen im Bereich der unteren Extremitäten und der unteren Abschnitte der Bauchhöhle die von mir erprobte und eingeführte »Sakrolumbalanästhesie«, ein neues Betäubungsverfahren, dessen bisheriger Erfolg seine Veröffentlichung, mit gleichzeitigem Ersuchen um weitere Erprobung, vollauf rechtfertigt. Das Verfahren beruht darauf, daß, durch die gleichzeitige intra- und extradurale Einführung kleiner, für den Organismus unschädlicher Gaben des Betäubungsmittels (Novokain), derselbe Erfolg, sowohl in bezug auf den Umfang, als auch auf die Zeitdauer der Anästhesie, erreicht wird, wie wir ihn von jedem der vorgenannten Räume getrennt, jedoch nur bei Anwendung weit höherer Gaben, zu erreichen pflegen.

Mit anderen Worten, wir erreichen mit unserem Verfahren denselben Erfolg, den wir mit der sogenannten hohen Sakralanästhesie oder mit der Lumbalanästhesie (jedoch nur in der gegenwärtigen Anwendungsform) zu erreichen pflegen, ohne den Pat. den Gefahren der beiden letzteren Methoden auszusetzen.

Die ermittelten Einzelgaben betragen: 4—5 ccm einer 1%igen Novokainlösung (d. i. 0,04—0,05 g Novokain) intradural und 40—50 ccm einer gleichfalls 1%igen Novokainlösung (d. i. 0,4—0,5 Novokain) extradural eingeführt.

Es ist wohl bekannt, daß an die Ausführung einer Leistenbruchoperation bei intraduraler Einführung von 0,04 g Novokain in 1%iger Lösung nicht zu denken

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ist, weil Leistenbrüche infolge Innervation des Operationsfeldes von höheren Rückenmarksabschnitten aus, nicht immer, selbst bei Anwendung viel höherer Novokaindosen und in bedeutend stärkerer Konzentration, schmerzlos operiert werden können. Eine Dosis von 0,04—0,05 g Novokain in 1%iger Lösung (4—5 ccm einer 1%igen Novokainlösung) führt eine nur sehr kurzdauernde und nicht ausreichende Betäubung herbei, in welcher ein schwerer, länger dauernder operativer Eingriff — wie wir uns wiederholt zu überzeugen Gelegenheit hatten — nicht ausgeführt werden kann, wogegen die gleichzeitige Einführung der beiden vorangeführten kleinen Einzelgaben für gewöhnlich eine ausgezeichnete Betäubung der unteren Extremitäten und der unteren Abschnitte der Bauchhöhle herbeiführt, von 1—2stündiger Dauer.

In der Sakrolumbalanästhesie wurden bisher ungefähr 200 Operationen ausgeführt, darunter Leistenbruch- und Wasserbruchoperationen, Exstirpation und Resektion des Mastdarms, Sectio alta, Prostatektomie, Amputation der unteren Extremitäten, Resektion des Knies und Hüftgelenkes u. dgl.

Das Verfahren versagte in 3 Fällen, in welchen jedoch begangene technische Fehler nicht ausgeschlossen werden können.

Wie bereits erwähnt liegt der Hauptvorzug des Verfahrens darin, daß bei gleich guter Betäubung, wie wir sie mit der hohen Sakral- oder der Lumbalanästhesie (in der augenblicklichen Anwendungsform) erreichen, der Pat. den zahlreichen Gefahren, Neben- und Nachwirkungen dieser beiden Methoden nicht ausgesetzt wird.

Außer Kopfschmerzen leichteren Grades, welche in nur 8% unserer Fälle auftraten, beobachteten wir keine der bekannten unangenehmen und unerwünschten Erscheinungen, welche insbesondere bei der Lumbalanästhesie beobachtet werden und ihre wesentliche Einschränkung in der Chirurgie zur Folge hatten. Auch die Gefahren der hohen Sakralanästhesie sind zu gut bekannt, als daß sie hier erörtert werden sollten.

Die Kopfschmerzen dauerten in unseren Fällen 1—3 Tage, erforderten niemals ein energischeres therapeutisches Eingreifen, wie z. B. Lumbalpunktion oder Infusion physiologischer Kochsalzlösung u. dgl.

Meiner Ansicht nach dürfte der Ausfall der unangenehmen Nebenerscheinungen bei unserem Verfahren, außer der geringen Dosis des (0,04—0,05 g) intradural und (0,4—0,5) extradural einverleibten Novokains, vorzüglich auch dem geringen Konzentrationsgrad (1%) zuzuschreiben sein, in welchem das Anästhetikum intradural eingeführt wird.

In den letzten 10 Fällen bedienten wir uns einer Dosis von 5 ccm einer ½%igen Novokainlösung (d. i. 0,025 g Novokain) zur intraduralen Injektion, ohne einen Mißerfolg verzeichnet zu haben. Wir mußten nur etwas länger den Eintritt der Betäubung abwarten, welche bei Anwendung einer 1%igen Lösung momentan einzutreten pflegt.

Wenn wir erwägen, daß die Literatur bei Anwendung der Lumbalanästhesie keinen Todesfall zu verzeichnen hat, sofern die Dosis von 0,05 Novokain in 1%iger Lösung nicht überschritten wurde, und daß auch bei Anwendung der sogenannten tiefen Sakralanästhesie (d. i. 0,4—0,5 Novokain in 1%iger Lösung extradural) bisher kein Todesfall verzeichnet erscheint, so können wir ruhig unser Verfahren nur insofern als gefährlich ansehen, als die Lumbalpunktion als solche und die mit ihr verbundene Infektionsgefahr des Duralsackes in Betracht gezogen wird, welcher Umstand jedoch, bei der heutigen Aseptik, bei Beurteilung unseres Verfahrens kaum in die Wagschale fallen dürfte.

Figure 4. Rodziński R. Über eine neue Betäubungsmethode der unteren Körpergebiete: Sakrolumbalanästhesie. Zentralblatt für Chirurgie 1923; 50: 1249–1251 [14]

90 *Correspondence*

two cases that received 4 mg of morphine in 20 ml normal saline were unrelieved of pain. There was also such a high incidence of the now well known undesirable side-effects,[6-9] that I came to the conclusion that it is unethical to use it. It may be that preservative-free pethidine[10,11] or fentanyl[12] would be less troublesome, but for the present I have reverted to relying on the appropriate dose and concentration of bupivacaine.

The ideal long acting drug for postoperative analgesia via the epidural route and allowing for early patient mobilisation is not yet available, but in the future it may be that the simultaneous administration of a subarachnoid anaesthetic and some ultra-long-acting epidural analgesic via a single intervertebral space will provide both surgical anaesthesia and prolonged postoperative analgesia with patient mobility, without the need for an indwelling epidural catheter.

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Another single space technique for orthopaedic surgery

Many orthopaedic surgeons are not happy with epidural analgesia. They complain that it does not give adequate muscle relaxation and that it is not satisfactory for surgery on the ligaments. We, therefore, routinely use isobaric subarachnoid spinal analgesia with 0.5% bupivacaine for surgery on the lower limbs unless the technique is contra-indicated; this provides good conditions for operations lasting for up to 4 to 6 hours; in addition we have, in the past, also introduced an epidural catheter through a different space in a few cases. Such an epidural cannula may be used to supplement the spinal analgesia if it is showing signs of wearing off, to prolong the analgesia into the post-operative period and to provide a route for an epidural infusion of saline should this be desirable if the subarachnoid block causes a 'spinal' headache.

The use of separate spaces for the subarachnoid block and the epidural catheter made the process a time consuming procedure, however; we, therefore, now use the same interspace for both procedures. The epidural space is first entered with a 16-gauge spinal needle and a longer 25-gauge spinal needle is passed through it and into the subarachnoid space; the required dose of 0.5% bupivacaine (isobaric) is then injected. The 25-gauge spinal needle is then withdrawn and an epidural catheter inserted through it into the epidural space. There is no need for undue haste in inserting or arranging and fixing the epidural catheter in position, as an isobaric solution (0.5% bupivacaine) is being used for the subarachnoid block.

We have now used this single space technique on 15 patients with very satisfactory results and without complications.

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Figure 5. Mumtaz MH, Daz M, Kus M. Another single space technique for orthopaedic surgery (letter), *Anaesthesia* 1982, 37 (1): 90 [15]

brought his professional and academic career to a standstill. In January 1938, because of his deteriorating health, he left for Vienna to receive treatment and died there on March 12, 1938, aged only 48 years old. Indeed, one Lviv newspaper wrote about "the premature death of one of the best Polish surgeons, a man of extreme kindness and 'crystal-clear' character" [7].

Professor Marian Kuś was a medical doctor whose scientific studies were closely connected with Dr Rodziński's scientific work and who also contributed to the development of local anaesthesia. He was the founder and organiser of the Pain Management Department at the Cracow medical school in 1978, and later, during the period 1994-1997, was the Head of the Chair and Department of Anaesthesiology and Intensive Care at Jagiellonian University Medical College. About 60 years after Ryszard Rodziński's publication, Professor Kuś and his associates, Dr Mumtaz and Dr Daz, were the first to demonstrate a technique of local anaesthesia known today as *combined spinal-epidural analgesia*. This method was presented in the "Letters to Editor" section of the journal *Anaesthesia* in 1982 [15] (Fig. 5). Professor Marian Kuś died in Cracow on May 30, 2010.

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