

Contributions to Belgian anesthesia: dr. Leo Vaes

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Key Words : Anesthesia, safety, training, education, history.

INTRODUCTION

Dr. Leo Vaes (Fig. 1) continues to inspire many of his colleagues and former trainees because of his passion for anesthesia, his visionary contributions during the early days of anesthesia in Belgium (1960-1970s), and his belief in the absolute necessity to scientifically underpin everything you do in medicine. This article reviews Dr. Vaes' legacy at the local, national, and international level. He was a perfectionist who continually tried to improve patient care and safety; he scored several "firsts" in anesthesia; he was very selective when expanding his team; and he created a remarkable anesthesia training program. Patient safety was his number one priority: he was the first to use capnography in Belgium, and he was a member of the group that wrote the anesthesia safety standards by the Board of Directors of the Belgian Society of Anesthesia and Reanimation in 1989 (1).

Leo Vaes (12.06.1931-26.11.1990) was born and raised in Heist-op-den-Berg, Belgium, the son of famous Flemish fruit grower and cultivator ('Prunica Persica Vaes'). His marriage with Christiane De Rammelaere was blessed with four children. Leo Vaes passed away far too early at the age of 59.

THE EARLY YEARS : BUILDING THE FOUNDATION OF A MODERN ANESTHESIA DEPARTMENT

After attending high school at the Scheppers Instituut in Mechelen, he studied Medicine at the Universities of Ghent (first year) and Leuven (Louvain), all in Belgium. Because he never had studied Latin in high school and an official grade in Latin was required to enter medical school at that time, he had to study Latin in summer and pass a national test. After graduating from the University of Louvain, Leo started in 1958, a 4-year anesthesia

residency at the St. Elisabeth Hospital in Tilburg, the Netherlands (the first anesthesiologists only started to appear in Belgium in 1945!). There, he became familiar with the concept of the anesthesia team (anesthesiologists working with nurse anesthetists). In July 1962, Dr. Vaes started working as a private anesthesiologist at the St. Elisabeth Hospital in Turnhout, Belgium. The hospital, founded in 1608, had opened its new facilities just a few years earlier (1957) and was considered one of the more modern and larger non-academic health care centers in Belgium. In the early years after his training, Dr. Vaes strongly felt the need to further educate himself. He went to Dr. Kirchhoff (Denmark) to learn more about regional anesthesia, and he observed the practice of neuroleptanesthesia as administered by Dr. J. De Castro (the first anesthesiologist to clinically use fentanyl and a co-researcher of Dr. Paul Janssen). Dr. De Castro introduced him to Dr. Albert Van Steenberge (Fig. 1; 1925-2010), who also had mastered neuroleptanesthesia.

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Paper submitted on Feb 04, 2019 and accepted on Feb 20, 2019.

No funding received – No conflict of interest – Presented in part by Prof. André Van Zundert, at the 6th Annual NAVAt Meeting, Aalst, September 22, 2018.



Fig. 1. — Drs. Leo Vaes, Albert Van Steenberge, and Maurits Soetens.

Dr. Van Steenberge was a pioneer anesthesiologist himself. He had trained in Louvain (1950-1953), Stockholm (cardiothoracic anesthesia; 1953), Montreal (regional anesthesia; 1953-1954), and Leiden (induced hypothermia; 1959). Dr. Van Steenberge was the head of a well-organized private anesthesia practice group in and around Kortrijk, Belgium. He was one of the first anesthesiologists in Belgium to have a well-equipped recovery room, and he was very experienced in regional anesthesia (brachial plexus block, epidural and caudal anesthesia). In addition, he had created a residency program, requiring his residents to complement their training by going elsewhere. Some of Dr. Van Steenberge's former trainees include Achiël Bleyaert, Paul Dauchot, Maurits Soetens, Valère De Rijcke, and Raf Verbist; they attended residency programs such as Case Western Reserve University Hospital, Cleveland, and UPMC Pittsburgh (AB), Gainesville (PD), UCSF San Francisco (MS), Stanford (VDR), and Miami (RV) in the USA.

All these facts captured Dr. Vaes' interest much more than neuroleptanesthesia. Dr. Vaes once stated that the way that Van Steenberge's department was organized was "the culmination of his insights and international training". At that time Leo was very frustrated with the state of affairs in most Belgian hospitals (in his opinion poorly equipped and managed), especially the fact that it was the surgeon who determined the choice of his anesthesiologist. His observations in Kortrijk gave him renewed energy to build Turnhout into a modern anesthesia practice.

During his visits to Kortrijk he met one of Dr. Van Steenberge's residents, Dr. Maurits Soetens

(Fig. 1). Dr. Soetens was Dr. Van Steenberge's first resident who went to the USA for additional training: he spent one year (1966-1967) at the University of California San Francisco with Prof. Stuart Cullen (Department Chair, later Dean). UCSF was a large, well-organized and well-functioning academic department. At UCSF, Dr. Soetens met giants in general anesthesia (Profs. Severinghaus, Gregory, Larson, Miller), obstetric epidural analgesia (Prof. Sol Shnider), and inhalation anesthesia (Prof. Edmond I. Eger II).

Dr. Vaes realized rapidly that he and Maurits shared similar interests and that they were both very motivated to promote the practice of regional anesthesia, build a modern anesthesia department, and get anesthesiologists involved in the management of the hospital. On 01.11.1968, Dr. Soetens became Dr. Vaes' first associate, forming a highly motivated and diversely educated team eager to build a modern anesthesia department!

THE EXPANSION OF THE ASSOCIATION

Both Dr. Vaes and Dr. Soetens had worked in practices that were based on the anesthesia team model (with nurse anesthetist), Leo in The Netherlands, Maurits in Kortrijk and San Francisco. Thus, when the workload in Turnhout increased (at least in part the result of the success of labor epidurals), they decided to work with a team consisting of anesthesiologists, nurse anesthetists, and residents. Because at that time it was difficult to find graduating anesthesiologists with experience in regional anesthesia, they decided to adapt Van Steenberge's system from Kortrijk: start their

own residency program, expose the residents extensively to regional anesthesia (first epidurals on the first or second day of training, resulting in a cumulative experience of > 1500 epidurals at the end of training), and require the residents to receive additional training in centers of excellence elsewhere. This allowed them to expand their own team with anesthesiologists with skills and capabilities they expected and demanded (e.g., Drs. Herman Meeuwis and Agnes Van der Donck). In a few years they had developed an anesthesia practice consisting of anesthesiologists, MD-supervised nurse anesthetists, and residents, which resulted in a training program that allowed residents to both provide patient care and focus on education.

UNIQUE ANESTHESIA TRAINING PROGRAM

Dr. Vaes was convinced that the route towards improving the practice of anesthesia in Belgium was through better training of young physicians. Initially, he only accepted one trainee per year. Dr. Vaes' adagio was: "We do not need trainees to help provide the clinical care - we want trainees to keep us on our toes and stimulate us to stay updated, which will make us better doctors". Competition to get a position as an anesthesia resident at the St. Elisabeth hospital was fierce. The program consisted of 2 years of basic anesthesia training in Turnhout, followed by 2-3 years of practice overseas, usually the USA, UK or the Netherlands. Flemish doctor Achiel Bleyaert, one of Dr. Van Steenberge's residents and colleagues, had moved permanently to the USA (1969) and was on faculty at the University of Pittsburgh Medical Center (UPMC) between 1973 and 1985. Achiel rose to the position of Professor of Anesthesiology in 1980 and would host and mentor many trainees from Turnhout. In order to be able to go overseas, the residents were required to take part in several courses, but also to become ECFMG certified and to pass an English test. Later, Turnhout-trained Dr. André De Wolf would take over Dr. Bleyaert's role and become mentor of several residents from Turnhout. Professor De Wolf specialized in anesthesia for liver transplantation, worked at UPCM in the team of YooGoo Kang (anesthesiologist) and Thomas Starzl (surgeon, liver transplantation pioneer) and later relocated to Chicago's Feinberg School of Medicine at Northwestern University.

Dr. Vaes welcomed each anesthesia trainee in Turnhout with a "gift" – a book that had to be read within four weeks. Usually, it was a standard

textbook such as 'Physics for the Anaesthetist' by Sir Robert Macintosh, 'Anesthesia Equipment', authored by Jerry and Susan Dorsch, or 'Applied Respiratory Physiology' by J. F. Nunn. Soon other books followed: 'Anatomy for Anaesthetists' (Harold Ellis et al.), 'Regional Block' (Daniel C. Moore), 'Epidural Analgesia' (Philip Bromage), and finally a major textbook, Wylie and Churchill-Davidson's 'A Practice of Anaesthesia' (this was years before 'Anesthesia' edited by Ronald D. Miller became the standard textbook). One particular book, Dr. E.I. Eger II's 'Anesthetic Uptake and Action' of inhaled anesthetics was taught in detail by Dr. Soetens. Numerous hours were spent to help the residents master the concept of "MAC" and the pharmacokinetics of inhaled anesthetics.

Dr. Vaes gave a book from his personal library, Lowe and Ernst's 'The Quantitative Practice of Anesthesia – Use of Closed Circuit', to one of his residents, Dr. Jan Hendrickx, who had a major interest in lowering fresh gas flow. With Leo's help, he learned how to lower the fresh gas flow from 6 to 2 L/min with a Blease anesthesia ventilator – the start of a long quest by Jan Hendrickx and Andre De Wolf into the kinetics of anesthetic gases at even lower fresh gas flows. Later, Dr. Jan Hendrickx will write a PhD-thesis with André De Wolf and André Van Zundert, 'The Pharmacokinetics of Inhaled Anesthetics and Carrier Gases', based on and including a thorough discussion of the General Anesthetic Equation (low flow concept) (2). Both Hendrickx and De Wolf continue to publish on the topic and each year organize a scientific meeting NAVAt (navat.org) in Aalst, Belgium, that focuses on automated low flow anesthesia and visual drug display systems (3). It can be argued that Dr. Vaes and Soetens' mentorship ultimately led their residents to accomplish this. In 2018 André De Wolf and Jan Hendrickx recognized and honored Leo Vaes' mentorship with the first NAVAt Leo and Christiane Vaes lecture, which was presented by Bart Westerkamp, inventor of the PhysioFlex® closed-circuit anesthesia machine, and who shares the same passion about anesthesia workstations Leo Vaes had.

Leo Vaes took his leadership's role in teaching residents to heart and literally went to great depths: being a passionate diver, he invited residents to his outdoor swimming pool to teach them about the theory and practice of lung physiology and about the safety issues while scuba-diving. Leo provided the diving gear and allowed the resident to experience breathing while resting on the bottom of the swimming pool for half an hour, a practical

workshop not too many residents will experience and for sure will never forget.

ANESTHESIA CARE IN TURNHOUT

A. Private Practice Association Group of Anesthesiologists and In-house anesthesia call coverage

In the middle of the last century, many anesthesiologists in Belgium worked for a particular surgeon or for a small group of surgeons. Drs. Vaes and Soetens considered working as a group of anesthesiologists to be the better way to deliver anesthesia care because it allowed them to prioritize patient care over gratuitous surgeon satisfaction. Initially, they provided anesthesia care at two hospitals in Turnhout (for some surgeons) and one hospital in Arendonk, all in the north of Belgium; later they would only practice at the St. Elisabeth Hospital in Turnhout for all surgeons, after the early passing away of a dominant surgeon. This “group” of two anesthesiologists would gradually expand (Drs. De Vel and Van der Aa) to form a dynamic group of trusted colleagues, where team work, intellectual cross-pollination, and uniformity of care were fundamental to improve anesthesia care.

In the 1960s-1970s, anesthesiologists had to buy their own equipment, including anesthesia machines and all airway equipment such as red rubber tubes, face masks, and oropharyngeal airways. Working as a group practice (which they referred to as “ANRE”: ANesthesia and REanimation) resulted in standardization of equipment, and Leo’s focus on anesthesia equipment was a major advantage for this group practice model.

In addition, from 1980 onwards, the 24/7 in-house presence of an anesthesiologist was established after a child with a bronchopleural fistula repeatedly extubated herself in the ICU (the child would later become a doctor herself). In other training centers, residents stayed in-house and attending physicians were only called in from home if necessary. This aspect of their practice model gained considerable respect from their surgical colleagues and the hospital administration, which facilitated the further expansion of the anesthesia team and practice.

B. Epidural analgesia care of parturients

Dr. Van Steenberge had shown his colleagues, including Leo and Maurits, how to use epidurals for surgical interventions, but Albert had used epidurals also for the control of delivery pain. With

Maurits Soetens’ extensive experience with labor epidurals in San Francisco, Leo and Maurits started a new service to provide analgesia during labor to parturients, but – and this was revolutionary – now using a low dose, low concentration of local anesthetic solution (bupivacaine 0.125 %) to which adrenaline 1:800,000 was added. This solution had been suggested by Dr. Bleyaert (who had used this concentration when providing epidural analgesia for his wife). Fifty years ago, on 2 December 1968, the first epidural for pain relief during labor and delivery in Turnhout was administered by Dr. Soetens, followed two months later by a second epidural by Dr. Vaes. In that first year, some 100 women received an epidural during childbirth. The epidural technique became so popular that parturients from all over Belgium came to deliver their babies in Turnhout. The experience with this low concentration resulted in a publication in 1979 in *Anesthesiology*: ‘Bupivacaine, 0.125 %, in Obstetric Epidural Analgesia: Experience in three thousand cases’ (4). Their concentration was much lower than that commonly used in the USA and UK in those days, 0.25% or even 0.5% of bupivacaine. Later, one of Vaes and Soetens’ residents, André Van Zundert, would further investigate the technique in Turnhout and publish numerous articles on the merits of this low dose, low concentration epidural analgesia technique, which culminated in a PhD-thesis and a standard textbook, ‘Pain Relief and Anesthesia in Obstetrics’ edited by Van Zundert and Harvard Professor Gerry Ostheimer (5).

In the early pioneering years, obstetric regional anesthesia practitioners in many institutions, placed small-diameter ureter catheters into the epidural space through reusable 14 G Tuohy needles. However, in Turnhout Vaes and Soetens designed their own epidural tray that contained a single use PVC epidural catheter (with 3 helical side openings), a 16 G reusable Tuohy needle, and a 20 mL Standard Socorex syringe (all metal, except for the glass barrel, from which the spring was removed) that allowed accurate and smooth detection of the epidural space with a loss-of-resistance to saline technique; a small air bubble made sure that a stuck plunger would be recognized. It was proven that the large surface area of the plunger compared to that of the needle improved the sensation of loss-of-resistance to saline once the epidural space was entered; the incidence of wet taps was less than 1/2,000. New was also that the staff anesthesiologist would stay in the hospital during the entire labor and delivery period, and that the service was offered 24/7. A specific anesthesia record was developed to

Poland, and Germany. Later, both Van Steenberge and Van Zundert would play a distinctive role in the establishment of the European Society of Regional Anaesthesia and Pain Therapy, where they became members of the Board of Directors.

D. Equipment in General Anesthesia

Dr. Vaes' focus on equipment added a special dimension to the practice. Leo Vaes' interest in anesthesia machines and ventilators led him to meticulously study the mechanical (and later the electronic) aspects of different ventilators. You could see him discussing anesthesia machines for the longest time with Mr. Freddy Braem (a distributor of anesthesia equipment, and father of Kristof Braem, founder of MEDEC®, Aalst, Belgium). One of Leo's remarks was exemplary: "You can always ventilate a patient with 16% oxygen if your ventilator fails, as our creator has given you the power to breathe out".

Capnography was introduced in the Benelux by Leo Vaes (Belgium) and Bob Smalhout (the Netherlands) in the early 1960s, several years ahead of its introduction in the USA in 1978. This is a clear example of Leo's pioneering spirit. The first capnograph installed in Turnhout was a huge, complex machine. It required a thorough monthly calibration with a reference gas which had to be repeated if soiling by airway secretions occurred, which could happen easily because there were no filters. A less rigorous but still time-consuming calibration had to be performed daily. One of the early capnographs was manufactured in the Netherlands by the company Godart (6). The end-expired (maximum) CO₂ value had to be estimated from the needle indicator, while a printer could be used to follow the trend (at low paper speed) or observe the capnogram (at high paper speed). Later, more modern capnographs would be acquired by the department (Fig. 3). Similarly, blood gas analysis was a time-consuming and complex procedure. Modern anesthesia vaporizers were acquired as well. This was not always as simple as it is today: when Leo Vaes went to London to buy a few of these vaporizers, he became a victim of a pickpocket in the London metro and lost the 20.000 BEF (~500 euro) he carried on him.

In these early days, electrocardiography (ECG) was not routinely used during anesthesia. To continuously monitor heartbeat and ventilation, a precordial stethoscope (Figure 4) was applied, consisting of a personalized earpiece that was connected via IV tubing to a stethoscope taped to



Fig. 3. — Godart Capnometer, produced in the Netherlands, distributed by Van Der Heyden in Belgium.

The "mains" was always switched on as the measuring cell needed to be warmed up before use. Below the on-off knob (mains), the air pressure had to be adjusted to the atmospheric pressure. During calibration, the meter (arrow) was put on the red dot on the Vol. % CO₂; next the 0 knob to calibrate zero value of CO₂; the switch had to be put subsequently on: a) operate; b) zerogas = 0; and c) calibrate = 6. Next sits a flowmeter, a control knob for exhaust speed and a printer with adjustable print speed to obtain a trend or capnogram.



Fig. 4. — Personalized earpiece connected through IV tubing to a stethoscope, taped to the precordial area, to monitor heartbeat and respiration.

the precordial area. A sphygmomanometer, fixed to the operating table, was used to measure the patient's blood pressure based on oscillometric measurements rather than auscultation through a stethoscope. Anesthesia machines were stand-alone units without monitors and were not available in

all operating rooms; this likely contributed to the success of regional anesthesia at that time.

Red rubber endotracheal tubes were used (later replaced by PVC tubes). Disposable PVC IV catheters were non-existent at the time, so after needle insertion the needle was taped to the forearm with the syringe attached to allow administration of additional drugs. These metal needles required special insertion skills and had to be resharpened repeatedly by the nursing staff. Soon, disposable IV catheters replaced them. Oxygen and nitrous oxide in the operating rooms were provided from gas cylinders with manometers. Later, a central gas supply system was installed, which made the administration of anesthesia much more convenient and safer, although it was not fool-proof (7). The department of anesthesia in Turnhout insisted that each time maintenance of the central gas supply took place, it was tested before there was any patient contact. Indeed, mishaps due to the use of non-standardized connections, due to mix-ups caused by inconsistent international color coding, due to misuse of medical gas supply systems, or due to human error, have cost many lives. Finally, precordial Dopplers were used during laparoscopic procedures to allow the early detection of gas embolism.

E. Anesthesia registration system

Continuing to be inspired by their international experience, they implemented an anesthesia registration system (anesthesia record) to facilitate documentation of perioperative data of surgical patients, including patient characteristics, medical/surgical history, use of medication, and allergies. At the end of the 1970s, the department of anesthesia had an automated computerized system, which was also used for automatic billing. After preoperative rounds in the evening, all the patients' names had to be entered. The computer returned a code (0, 1, or 2). These numbers referred to previous problems during surgery, such as history of anaphylaxis, difficult airway, and plasma cholinesterase deficiency. A code 2 meant that the chart of the previous surgery had to be looked up in the anesthesia archive room – without it, surgery would not proceed.

F. Nurse anesthetists

Leo Vaes and his colleagues trained nurse anesthetists on the job. They were extremely well-versed in holding a face mask, considered to be the best “life monitors”, and were involved in providing

anesthesia care during the maintenance phase. They were also very helpful with checking and calibrating equipment, taking on roles as anesthesia technicians “avant la lettre”, but never induced anesthesia, performed regional blocks, or placed central lines. Drs. Vaes and Soetens contributed significantly to the training of nurses at the nursing school in Turnhout, where they lectured not just about anesthesia but other medical topics as well.

G. Fully equipped and staffed recovery and ICU departments

In the 1960s, patients usually recovered lying on the side in a corridor near the operating rooms, unmonitored. Dr. Vaes and his team established a fully equipped recovery unit with staff and adequate monitoring equipment well ahead of other non-academic institutions. In 1980, Turnhout also had established a dedicated intensive care unit (ICU), which until then had only been available at university hospitals.

OTHER CONTRIBUTIONS

A. Professional administrative contributions

Dr. Vaes' enthusiasm to teach others and share his knowledge, his open-mindedness and quest to learn from others, his efforts to protect the specialty as a “free enterprise”, and his political commitment to improve the conditions for anesthesiologists in Belgium resulted in him being elected President of the Belgian Society of Anaesthesia and Reanimation. In addition, in the 1970s, the role of anesthesiologists in hospital management became more apparent, and anesthesiologists started to become respected for their independent input and participation in hospital decisions. His colleagues elected Dr. Vaes as medical director of the St. Elisabeth Hospital in 1978, a position traditionally dominated by surgeons and internists. This was, to a large degree, the result of all the contributions that Dr. Vaes and his team had made towards the overall functionality of the institution, greatly increasing its reputation. Later, Dr. Soetens followed in his footsteps and became medical director of the hospital for many more years.

B. International contacts

Leo Vaes made many friends while attending various scientific meetings. You always could see Leo sitting in the front of the meeting room.

Frequently, he went to meet the lecturer afterwards for further discussions. Back home, important information was shared with his colleagues and residents during the weekly teaching sessions. Leo and Maurits invited many of the 'big shots': Profs. Sol Shnider, Ron Miller, Ted Stanley, Philip Bromage, Stuart Cullen, Robert Willenkin, and many others visited the anesthesia department in Turnhout in an ever-lasting attempt to increase the quality of anesthesia and to exchange ideas.

C. Doctors' strike in Belgium

From April 1 through 18 1964, the largest doctors' strike ever in the Benelux history took place (8, 9). Some 10,000 Belgian physicians and dentists revolted against governmental efforts to establish a nationally controlled health care program that was considered to be the first step toward socialized medicine. This ensuing dramatic decrease in power and income would abolish the profession of physicians as an independent, free profession and enterprise. More than 95% of all physicians went on strike. The international press covered the event, revealing that some 3,600 army physicians were mobilized and were required to deliver their services in hospitals; those who refused would be considered to be deserters. This attempt of the government to break the strike resulted in a massive departure out of the country of thousands of physicians and dentists to France and The Netherlands, where they claimed to be on vacation. After 18 days, the government withdrew the proposition.

Several anesthesiologists, including Drs. Van Steenberge, Vaes, and Bleyaert took on leading roles in this revolt. For Dr. Van Steenberge, the 1964 doctors' strike would have nasty consequences: the hospital executives in Kortrijk dismissed him in December 1965. This resulted in a massive embargo for that hospital by all anesthesiologists. Dr. Van Steenberge would later start a private anesthesia practice at the St. Anne Hospital in Anderlecht, near Brussels.

D. Early Scientific Contributions

Dr. Vaes wrote several scientific manuscripts early in his career, including 'Practical lessons for painless deliveries' (1959), 'Control of halothane vaporizers' (1962), and 'Measuring of CO₂ in gas mixtures' (1963). The latter documented how he applied capnography in his practice (10). Many more scientific contributions of the department would follow.

Dr. Vaes clearly saw how technological advances such as CO₂ monitoring and anesthesia machine design were fundamental for the future of anesthesia, a message still carried forward in the academic work of his former residents Jan Hendrickx and Andre De Wolf.

CONCLUSIONS

In the 1960-1970s, Dr. Leo Vaes and his colleagues created a high-quality private practice anesthesia department in Turnhout, an accomplishment that was virtually unseen in the country at that time. Its standards sometimes even surpassed those of academic departments, standards that he later wrote into national standards with colleagues from academia and private practice. Leo had a passion for anesthesia and found personal reward and happiness in advancing the profession. He continually sought to improve and perfect patient care, and in doing so achieved several "firsts in anesthesia". He carefully selected his colleague staff members, and developed an outstanding anesthesia training program with international links. Leo would take pride in what has been accomplished since his arrival in Turnhout some 60 years ago, but also in the achievements of his trainees who practiced across Belgium and abroad. Early on, Leo's visits to Kortrijk made it clear to him what the ideals in anesthesia should be: he realized that it required a coherent, well-organized and dedicated team of practicing anesthesiologists working together as one group. In addition, it required a professional caretaker of patients, continuous study, being very creative in finding solutions for diverse problems in anesthesia, and sharing knowledge by teaching and publishing. As trainees in anesthesia, we could not find a better professional role model than Dr. Leo Vaes.

Acknowledgements

The authors acknowledge the valuable contribution of Ms. Els Vaes (daughter), Dr. Frans Hendrickx (lifelong trusted high-school friend of Leo and the Vaes family, and father of Dr. Jan Hendrickx), and Dr. Maurits Soetens (colleague anesthesiologist of Dr. Leo Vaes), for all the help in retrieving and checking essential facts presented in this manuscript. The authors are also indebted to the contributions of Mrs. Françoise Van Steenberge-Morre (married to Dr. Albert Van Steenberge), Dr. Herbert van Craeyvelt (anesthesiologist Gent, former Vaes trainee); nurse anesthetists Rumolda

van Beek, Rita Rombouts, and Chris Caers; and Elly Leysen (secretary Dr. Vaes).

References

1. Gribomont B., Lamy M., Rolly G., Vaes L., Van Aken H., and the Belgian Anesthesia Patient Safety Steering-Committee. 1989. Belgian standards for patient safety in anesthesia, *Acta Anaesthesiol. Belg.* 40:231-238.
2. Hendrickx J.F.A.. 2004. The pharmacokinetics of inhaled anesthetics and carrier gases. PhD-thesis, Ghent University, Ghent, Belgium.
3. NAVAt., International Symposium on Automated Low Flow Anesthesia & Visual Drug Display Systems. Aalst, September 22, 2018
4. Bleyaert A., Soetens M., Vaes L., Van Steenberge A.L. and Van der Donck A. 1979. Bupivacaine, 0.125 per cent, in obstetric epidural analgesia: experience in three thousand cases. *Anesthesiology.* 51: 435-438.
5. Van Zundert A. and Ostheimer G. 1996. Pain Relief and Anesthesia in Obstetrics, Churchill Livingstone, New York.
6. Jaffe M.B. 2008. Infrared Measurement of Carbon Dioxide in the Human Breath: "Breathe-Through" Devices from Tyndall to the Present Day. *Anesth. Analg.*, 107:890-904.
7. Dangoisse M.J., Lalot M., Lechat J.P. 2010. Connection errors in the delivery of medical gases to a surgical unit, *Acta Anaesthesiol. Belg.* 61: 33-37.
8. Anon., Doctors in Belgium strike in a protest over Health Plan. *The New York Times*, 01.04.1964. <http://www.nytimes.com/1964/04/01/doctors-in-belgium-strike-in-a-protest-over-health-plan.html?> (accessed 24/04/2018).
9. Marchildon G.P. and Schrijvers K. 2011. Physician Resistance and the Forging of Public Healthcare: A Comparative Analysis of the Doctors' Strikes in Canada and Belgium in the 1960s. *Med. Hist.* 55: 203-22.
10. Vaes L. 1963. Het meten van kooldioxyde in gasmengsels die bij de narcose toegevend worden. *Ned T. Geneesk.* 107 II 47: 2211-2214.