DR. Rudolph Matas (1860–1957) has long been known as a giant of his profession (fig. 1). At the height of his career, Dr. Rudolph Matas was known throughout the country as an innovative surgeon. He was the Department Chair of Surgery at Charity Hospital for 32 yr and became world-renowned for his method of repairing peripheral artery aneurysms. Sir William Osler, M.D. (1849–1919; Professor, Department of Medicine, Johns Hopkins University of Baltimore, Maryland) even lauded him for his contributions to vascular surgery, and he is to this day referred to as the Father of Modern Vascular Surgery. The seal of the Southern Association for Vascular Surgery bears his likeness in honor of his many achievements and contributions to the field of vascular surgery. However, despite his considerable research and innovations in the fledgling field of anesthesiology at the turn of the 20th century, Dr. Rudolph Matas has been—for the most part—forgotten by the anesthesiology community.

Though born on September 1, 1860, just 30 miles from New Orleans, young Rudolph Matas spent most of his childhood split between Barcelona, Spain, and Paris, France.1 His father was a physician at a plantation in southern Louisiana, but after dealing with cotton speculators and the Union army, the elder Dr. Matas felt it prudent for his health and that of his family to leave Louisiana for a time. The Matas family later returned to the United States and settled in the newly annexed state of Texas in 1868.2 Eventually, Rudolph Matas found his way back to the New Orleans area and enrolled in the Medical Department of the University of Louisiana in 1877, which was soon after renamed Tulane University in honor of a generous donation.1 He was subsequently chosen to become a resident at Charity Hospital in New Orleans and became Dr. Rudolph Matas in March of 1880 at the tender age of 20 yr. Six years later, he was appointed as demonstrator of anatomy at his alma mater, a post he held for 8 yr until resigning to become professor and chairman of the Department of Surgery at Charity Hospital.2 He was chairman for 32 yr, until the age of 67 yr. Dr. William J. Mayo (1861–1939; Surgeon and Co-Founder, Department of Surgery, Mayo Clinic, Rochester of Minnesota) was most complimentary in describing Dr. Rudolph Matas. He was quoted as saying, “Dr. Matas was the best doctor the world had produced at that time.”2 In that era, many surgeons contributed to the development of safer surgical conditions, and during his tenure, Dr. Matas made significant and varied contributions to anesthesia as well as surgery.

Fig. 1. Rudolph Matas, M.D. Reprinted with permission from the Rudolph Matas Images Collection, Rudolph Matas Medical Library, Tulane University Health Sciences Center, New Orleans, Louisiana.

**Dr. Matas and Spinal Anesthesia**

The first clinical spinal anesthetic was attempted in Germany by Dr. Augustus Karl Gustav Bier (1861–1949) in April 1899 and was first performed in the United...
States by Drs. F. Dudley Tait (1862–1918) and Guido E. Caglieri (1871–1951; Surgeons, San Francisco, California) in October of 1899. Dr. Matas, however, was the first to report the clinical use of a spinal anesthetic in the United States. On November 19, 1899, Dr. Matas used an injection of subarachnoid cocaine—a synthetic cocaine substitute—to obtain spinal anesthesia for hemorrhoidal surgery. (Eucaine was used preferentially over cocaine because of eucaine’s “lesser toxicity and [its] capacity to stand boiling without decomposition.”) Drs. Tait and Caglieri performed their spinal anesthetics by entry through the sixth cervical space, whereas Dr. Matas preferred the lumbar approach. Dr. Matas wrote that “[Drs. Tait and Dr. Caglieri] believe that the spinal cord, like the brain, is tolerant of trauma, and do not fear the possibility of injuring it permanently with a fine needle while introducing the cocain[e] solution. Notwithstanding their confidence and the repeated successes they have obtained, I cannot consider it a safe route to the spinal canal, and cannot recommend it in the regular practice of spinal anesthesia.”

Instead, Dr. Matas advocated the use of a lumbar approach to spinal anesthesia, which was the site of administration of the first spinal anesthetic by Dr. Bier, stating that “it is only from the first lumbar vertebra downward that injury to the spinal cord can be avoided,” and that the lumbar vertebral spaces were both the largest and easiest to identify. He also noted that care had to be taken to prevent unnecessary loss of cerebrospinal fluid, because there were reports of serious consequences to removing too much fluid. In fact, Dr. Matas wrote, “Bier himself was made quite ill from this cause when the method was tried on himself by his assistant, Hildebrand.”

Dr. Matas was a strong early advocate of the use of spinal anesthesia at a time when many medical practitioners were reluctant to use intrathecal anesthesia. He performed approximately fifty spinal anesthetics with cocaine and eucaine and was amazed at the surgical condition provided, stating that the “result was extraordinary, not only a complete anesthesia of the body below the waist followed, but it gradually extended to the neck and head to a less degree, but sufficiently to pinch and puncture the skin of the face and neck without pain.” “The anesthesia was so complete that any cutting operation could have been painlessly performed in the upper extremities.” Dr. Matas wrote that his first spinal anesthetic patient “felt absolutely no inconvenience after the ligation and excision of the hemorrhoids, and insisted upon walking back to his ward.” However, as he himself said, “the chills, headache, vomiting and febrile rise which occurred so frequently made me doubtful of its advantage over general narcosis with ether.”

Dr. Matas also stated that “the dangers of spinal anesthesia with cocaine could not possibly be compensated by the simplicity of the technique or the effectiveness of the anesthesia, so much so, that I, in company with many other pioneers, abandoned it altogether until procaine was introduced by Braun in 1905.”

Interestingly, Dr. Matas described two adverse patient conditions that are well known to practitioners of spinal anesthesia today. In regard to adverse consequences of spinal anesthesia with cocaine or its synthetic equivalents, he wrote that “the most constant and unfailing symptom was the headache,” which typically “came on from 5 to 12 h after the injection” and was relieved by providing the patient with caffeine. Dr. Matas also reported a case in which a physician received a spinal anesthetic with cocaine for a perianal resection and in whom “there persisted a feeling of tingling and numbness about the feet that made him uncomfortable for more than 12 days after.” The description appears to mimic the transient neurologic symptoms known to follow spinal anesthesia.

The development of procaine as a spinal anesthetic reduced the toxic side effects of spinal anesthesia, and Dr. Matas again became a strong supporter of spinal anesthesia, eventually performing 232 procaine spinal anesthetics during his tenure at Charity Hospital. He advocated the use of spinal anesthesia “for the surgery of the lower extremities and in the infraumbilical regions.”

As Dr. Matas said in August of 1934, “Personally, I regard spinal anesthesia as the supreme attainment of regional anesthesia.” This enthusiasm for spinal anesthesia was evidently infectious, as many other members of the Charity Hospital staff, “especially the genitourinary surgeons and gynecologists, who found spinal anesthesia particularly adapted to their needs, practically did all their work with it.” Dr. Matas noted that “gradually all abdominal surgery up to the diaphragm became subservient to this practice” at Charity Hospital. He cautioned, however, that surgeons should be schooled in the techniques of both regional and local anesthesia. He wrote in 1909, It should be borne in mind that, after all, the method of spinal cocainization is only an extended though specialized form of neuro-regional anesthesia, and that as such it has its distinct anatomic limitations, and that while the area which it embraces represents the most fertile surgical territory in the body, there are still other numerous regions in which it is totally ineffective or inapplicable and in which the resources of local and regional anesthesia still find frequent and most useful application.

Dr. Matas and Regional Anesthesia

Dr. Matas was intensely interested in the realm of regional anesthesia beyond neuraxial blockade. He also experimented—with great success—with numerous selective anesthetic blocks for surgery. He details how to perform these blocks in a 1909 article for the Philadelphia Medical Journal, including knowledge of regional
anesthesia of nerves as small as the digital nerves of the hand to as large as blockade of the brachial plexus for amputation of the arm. The technique of regional anesthesia was quite different than that known to us today in the era of neurostimulatory technology. The “regional intraneural method,” as it was known, was discussed in detail by Dr. Matas in describing a regional anesthetic for surgery of the hand.

Dr. Matas first performed such a block of the upper extremity in January of 1898, opting to provide a regional anesthetic for a 76-yr-old man with an extensive ulcer of the right hand that involved both the dorsum and the hypothenar regions of the hand. Dr. Matas was concerned about the man’s general state of health. As he later described, “The patient was profoundly arteriosclerotic; his radials were hard and rigid as pipe stems and his heart was the seat of loud aortic and mitral murmurs which indicated advanced valvular lesions. He was a decidedly unfavorable subject for general anesthesia and I decided to anesthetize the hand by the direct neuroregional method. The musculospiral, the median, and the ulnar were readily and painlessly exposed . . . by separate incisions made over the region of the individual nerve-tracts where they are most superficial at the bend of the elbow; the nerves were then exposed and each injected with . . . 1% cocain[e] solution. This caused a slight fusiform swelling at the point of injection. The wounds were sutured, but the threads were not tied, to provide for further injection, and the entire region was protected by a carefully applied aseptic dressing. The arm was then exsanguinated by elevation and the elastic constrictor was applied over the middle of the arm. The anesthesia of the extremity was now complete from the fingernails to the elbow.”6

Dr. Matas compared the anesthesia of the operative field as being the same as that provided by a general anesthetic. At the completion of the surgery, the incisions at the elbow were sutured closed, and the constrictor was then removed. Dr. Matas noted that the “operation in this way was not only painless but bloodless,” and that the anesthesia persisted for approximately 20 min after removal of the tourniquet, long enough for this patient—as well as Dr. Matas’ other patients blocked in such a manner—to walk back to his bed from the operating room.5

Although he had originally agreed to collaborate with Carroll Allen, M.D., on the book Local and Regional Anesthesia, which demonstrated the current methods of regional anesthesia and local infiltration, Dr. Matas had to reduce his role on the project due to constraints of time. Instead, he provided information for the book and wrote the introduction to the groundbreaking text. First published in 1914, it preceded the publication of Dr. Gaston Labat’s influential book, Regional Anesthesia: Its Technique and Clinical Applications, by 8 yr. In his introduction to Local and Regional Anesthesia, Dr. Matas states that during his time at Tulane University, “we began to utilize the large clinical material at our command in the effort to diminish the indications for general narcosis, and to substitute for the immediate dangers of chloroform, which was then the routine anesthetic in almost all Southern clinics, the more laborious but far safer methods of peripheral analgesia.”7

In addition to his pioneering work with regional and spinal anesthesia, Dr. Matas experimented with large volume infiltration of dilute local anesthetic solutions subcutaneously for surgeries requiring local anesthesia. This local infiltration method provided anesthesia both due to a direct effect of the cocaine solution and due to the resulting edema of the tissues, and was used for surgeries where neither spinal anesthesia nor regional blockage of specific innervating nerves would be sufficient. Dr. Matas noted that “plain or distilled water when injected in sufficient quantity to edematize the papillary layer of the derm and subjacent tissues will suffice to produce a transient but painful anesthesia of the edematized area.”5 He further stated that the use of isotonic fluids instead of hypotonic fluids for injection prevented the osmotic action in the tissues, so that “the injection is entirely painless.”5

To accomplish this, he eventually developed a small hand pump (fig. 2), which allowed for the injection of large amounts of anesthetic fluid without having to refill the syringe multiple times or puncture the skin repeatedly. Dr. Matas reported that the results obtained by this method were far superior to those obtained with injections from conventional syringes.8 Unfortunately, the bottle of the hand pump was initially made of glass, which tended to break from time to time under the high pressures needed until Dr. Matas learned to use bottles made from metal instead.8 Provisions also had to be made to attach a small clamp at the stopper of the bottle because “in charging the bottle, the stopper will fre-

Fig. 2. The hand pump developed by Dr. Matas for the delivery of weak anesthetic solutions. From the original manuscript of Dr. Rudolph Matas, illustrated by Dr. Matas himself.8
drastically fly out while pumping, thereby causing much annoyance to all concerned.10

Charity Hospital became renowned as a major center for regional anesthesia in the early 20th century. Before Dr. Matas’ tenure as Department Chair, all surgeries at Charity Hospital were performed under general anesthesia. While Dr. Matas was Chair of Surgery, only 30% of all cases were done as general anesthetics, whereas 45% of all surgical cases were done as spinal anesthetics, and the remaining surgeries were performed under other methods of regional and local anesthesia. Dr. Matas once stated that the 4,562 spinal anesthetics performed between 1926 and 1932 represented “a remarkable showing for spinal anesthesia that has no parallel in any other institution of the same size in the United States, with the possible exception of Dr. W. W. Babcock’s Clinic at Temple University in Philadelphia.”4

Dr. Matas and Thoracic Surgery

Dr. Matas was also a pioneer in addressing one of the major problems with intrathoracic surgery in that era. Up to 1920, intrathoracic surgery was a rarely performed surgical procedure that carried a 50% mortality rate.3 Sudden surgical pneumothorax resulted in a rapid collapse of the ipsilateral lung, often leading to inadequate oxygenation of the patient, arrested respiration, and even death. In a meeting of the Southern Surgical and Gynecological Association in New Orleans in 1899, Dr. Matas stated that “until the danger of seriously interfering with the respiratory functions, by inducing acute collapse of the lungs, is clearly eliminated or is reduced to a safe minimum, the analogies between the pleura and the peritoneum from the surgical point of view will never exist.”10

Many different surgical techniques had been attempted up to that point, but none were adequate to prevent the high morbidity and mortality of intrathoracic surgery. Dr. Matas asserted that through the use of artificial respiration, intrathoracic surgery could be successfully accomplished, stating that “the ideal indication—viz., to maintain the respiratory function of the lung in the course of intrathoracic operations—can only be successfully met by a method of direct rhythmical insufflation of the lungs through the larynx or trachea which will neutralize the collapsing effect of atmospheric pressure by increasing the intrapulmonary tension.”10 At the time, the Fell mask had been used intraoperatively in an attempt to prevent surgical pneumothorax but was prone to failure due to loss of adequate seal around the mouth or due to obstruction by the tongue, which prevented inflation of air into the lungs.11 This situation could be extremely troublesome during delicate portions of the case, when the lung would suddenly collapse with the loss of ventilation and an open thorax.

Dr. Matas’ inspiration for a solution would soon come from the city of New Orleans itself. For years, the Fell-O’Dwyer intubating cannula had been used for the treatments of non-surgical opium narcosis and of acute obstructive laryngitis in diphtheria, as well as in the resuscitation of drowning victims around the country. More specifically, it had been used by Dr. Bloom at Charity Hospital in New Orleans for the treatment of narcosis.10 The apparatus consisted of a tube inserted in the glottis, which was directly connected to a bellows. This was used to insufflate air into the lungs, as well as to actively remove air from the lungs using a suction force. Through experimentation on animals and human cadavers, Dr. Matas found that active aspiration of air from the lungs was extremely detrimental, often resulting in hyperemia, mucosal edema, and collapse of smaller bronchi before the evacuation of all air from distal areas. A gradually increasing tension within the alveoli resulted and eventually became great enough to stop all circulatory flow within the lungs, typically resulting in death."11

Through his continued experimentation, however, Dr. Matas soon came to realize that “the expiratory part of the respiration aid is unnecessary in practice, and that all that is required, so far as the expiration is concerned, is that the apparatus used shall insufflate air into the lungs in sufficient quantity and under proper pressure” so that “the power generated and stored up in overcoming the resistance to inspiration [is] amply sufficient to carry on expiration.”10 In conjunction with Dr. John Smythe (Surgeon, Charity Hospital, New Orleans, Louisiana), Dr. Matas devised an artificial respiration device that consisted of a single graduated cylinder for the delivery of a precise volume of air up to 1,500 cm3, a mercurial manometer for the measurement of intrapulmonary pressure, and a Fell-O’Dwyer intralaryngeal cannula, modified with a port to allow for the administration of chloroform or oxygen during artificial respiration. This is shown in figure 3.11 Dr. Matas once described an instance in which this apparatus was used during an in-

Fig. 3. The Matas-Smythe modified Fell-O’Dwyer apparatus for artificial respiration during surgery. From the original manuscript of—and illustrated by—Dr. Rudolph Matas.11
trathoracic case, stating that “the pleura was opened freely, but the collapse of the lung which would have inevitably followed, and the bad symptoms that were beginning to be noticed, were immediately corrected by the Fell-O’Dwyer apparatus,” which he and Dr. Smythe had modified for this use.12 He went on to state, “It would now appear from all that has been said and done that no further discussion could be called for, at least on the value of a reliable apparatus for maintaining artificial respiration in the course of intrathoracic operations.”12 Thirty years after he first proposed the use of “artificial respiration” for thoracic surgery, Dr. Matas’ theory of intratracheal anesthesia became the standard of practice, and the breadth of thoracic surgery across the country began to increase dramatically as a result.9

Dr. Matas and Intravenous Fluids

Dr. Matas’ contributions to medicine and anesthesia continued. He was the first to give intravenous fluids to a surgical patient. Intravenous fluids were first given by Dr. Thomas Latta of Scotland in 1831 for the treatment of cholera to replenish their fluid and salt losses. In subsequent years, intravenous saline was used intermittently in New Orleans for the treatment of cholera outbreaks. Dr. Matas, however, expanded the scope of intravenous fluid replacement to the surgical patient in July 1888.12 He had just performed an amputation at the thigh on a 26-yr-old patient with a cavernous sarcoma of the leg. Six hours postoperatively, he found the patient to be “in a condition of profound shock when he was placed in bed, the pulse being very small, shallow, and rapid.”1 Two pints of a salt solution were warmed and infused through the basilic vein at Dr. Matas’ direction. After this infusion, Dr. Matas stated that the patient “felt as if a delightful cool wave were gently spreading over his body and was giving him new strength and life and wonderfully appeasing his thirst.”1 In addition, the patient’s pulse became stronger and increasingly regular and was no longer tachycardic. By the next morning, however, the patient had relapsed into his previous condition. Two more pints were injected in the same manner, but the beneficial effects were “more transitory than the first,” and the patient died soon after.

Before Dr. Matas’ experimentation with intravenous administration, there were two main ways in which to give supplemental fluids to a surgical patient who could not take oral liquids: proctoclysis (fluids administered by way of the rectum) and hypodermoclysis (administration by subcutaneous absorption). Neither proctoclysis nor hypodermoclysis were ideal, because both had variable absorption rates and were limited in the speed and amount of fluids that could be given.13

Dr. Matas continued to experiment further with intravenous saline in the surgical patient and eventually developed a hanging bottle and clamp for slower administration of intravenous fluids.1 Although he never abandoned the idea of intravenous fluids for surgical patients in shock, neither did he recommend the routine use of intravenous fluids in all surgical patients. He did, however, remark that a prophylactic continuous intravenous drip was especially useful in “the very feeble, ill-nourished patients whose ability to survive an operation is doubtful.”15 The routine use of intravenous fluids for the surgical patient evolved over the course of World Wars I and II.14

Summary

Because of his surgical contributions to medical knowledge, Dr. Rudolph Matas was hailed during his lifetime as a great surgeon and was honored by virtually every surgical society in existence at the time. Although his contributions to the field of surgery are great, his contributions to anesthesiology are no less important: intralaryngeal intubation and artificial respiration for general anesthesia; the advancement of spinal, regional, and local anesthesia to improve surgical conditions and safety; and the use of intravenous fluids in the resuscitation of surgical patients. He also provided a wonderful example of a lifetime of education and innovation for generations of physicians. Dr. Rudolph Matas was a physician of great vision, whose shoulders we stand on today, and without whom the expansion of the field of anesthesiology might not have been the same.

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