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Original Article

# The Experiments on Electrical Anesthesia in Italy in the Second Half of the Nineteenth Century. A Dispute Between a Fearless Surgeon Patriot and a Positivist Researcher

Marco Cascella, MD *

*National Cancer Institute "G. Pascale" Foundation, Naples, Italy*
*Department of Anesthesia, Cardiology and Endoscopy, Via Mariano Semmola, 80131, Naples, Italy*

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ABSTRACT

Electric anesthesia is the anesthesia, usually general anesthesia, produced by the application of an electrical current. This fascinating issue of the anesthesia history was made possible thanks to the pioneering experiments on electrotherapy and electrophysiology performed by two researchers: the neurologist Guillaume Duchenne (1806-1875) and the biologist Stéphane Leduc (1853-1939). The aim of this study is the review of the dispute between two Italian scientists on the effectiveness of electric anesthesia in the second half of the 19th century. One of the two contenders was Rodolfo Rodolfi (1827-1896), an Italian surgeon and patriot who took part in the First Italian War of Independence of 1848, whereas the other protagonist of the dispute was the positivist Plinio Schivardi (1833-1908), a pupil of Duchenne who brought to Italy his knowledge of electrotherapy, collecting these experiences in the *Theoretical Practical Manual of Electrotherapy*, the first book on the subject written in Italian.



## Electrical Anesthesia

*According to Stedman's Medical Dictionary*, electrical anesthesia is "the anesthesia, usually general anesthesia, produced by application of an electrical current."[1] In the case of general anesthesia, it is possible to use the term *eletronarcosis* as a synonym of electrical anesthesia. This fascinating issue of anesthesia history was made possible thanks to the pioneering experiments on electrotherapy and electrophysiology performed by two researchers: the neurologist Guillaume Duchenne (1806-1875; neurologist, eponymous describer of what became known as Duchenne muscular dystrophy; France) and the biologist Stéphane Leduc (1853-1939; France). Whereas Duchenne played an important role in the field of research of electrotherapy, focusing his studies on muscle diseases, Leduc carried out several experiments on electrical anesthesia in both animals (dogs and cats) and humans. Indeed, Leduc had tried electrical anesthesia on himself with an apparatus he invented.[2] He was a strong supporter of this technique:

> "Electric sleep will in the near future replace chloroforme and other anesthetics in all surgical operations.… Anaesthesia by chloroform, morphine, or ether is disagreeable, is always dangerous, and has often proved fatal."[3]

In truth, Leduc's studies were not the first experiments on electrical anesthesia. Previously, other attempts had been made; nevertheless, it is very difficult to acknowledge a significant scientific value in these experiments. Indeed, according to Marguerite Zimmer, electronarcosis was applied for the first time in Paris, France, during May-June 1847 by Fortuné Christophe Ducros (1808-1849; physiologist and anatomist; France). Unfortunately, Ducros' scientific research was never published, so it was forgotten.[4]

## The Protagonists of the Dispute

In the second half of the 19th century, two Italian scientists disputed the effectiveness of electrical anesthesia. One contender was Rodolfo Rodolfi (1827-1896) (Figure 1). He was an Italian surgeon and patriot who took part in the First Italian War of Independence of 1848, becoming chief physician at the Hospital of Brescia.[5] During the Third Italian War of Independence (1866), this hospital was located in a strategic place, near the burning theaters of war, so Rodolfi devoted himself to the care of the wounded. He reported that he had given treatment to 11,424 soldiers, attributing much of his success to a "revolutionary discovery": electrical anesthesia.[6]

Because Rodolfi had an adventurous life, we can trace a profile of a "romantic" scientist who spent most of his time on the battlefield. However, the 19th century was also the century of Positivism. According to this philosophical and cultural movement, theology and metaphysics are imperfect modes of knowledge because positive

* National Cancer Institute "G. Pascale" Foundation, Via Semmola, 80131, Naples, Italy. Tel.: +39 081 590 3 586; fax: +39 081 590 3 778.
*E-mail address:* m.cascella@istitutotumori.na.it.

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**Fig. 1.** Rodolfo Rodolfi (1827-1896): patriot and surgeon. Albumen color print (ca 1875).

knowledge is based only on natural phenomena and their properties and relations, as verified by the empirical sciences. In other words, *positive facts* are information derived from sensory experience and interpreted through rational or logical and mathematical treatments, so they form the exclusive source of all authoritative knowledge.

Rodolfi's opponent was the positivist Plinio Schivardi (1833-1908). He was one of the greatest exponents in Italy of physical medicine, which is now known as *physiatry*. His studies on hydrotherapy and rehabilitation represent cornerstones in the field. Schivardi, a pupil of Duchenne, brought to Italy his knowledge of electrotherapy, for which he designed a specific apparatus (Figure 2). These experiences were collected in the *Theoretical Practical Manual of Electrotherapy* (Figure 3), the first book on the subject written in Italian.[7,8] This is the profile of a "positivist" scientist not distracted by the upheavals of history because he was only interested in scientific knowledge.

## The Dispute

Schivardi followed Rodolfi's experiments with interest. Rodolfi proposed a method using a specific galvanic device. Classic Duchenne's faradic devices were heavily influenced by the Ruhmkorff coil (an electrical transformer used to produce high-voltage pulses from a low-voltage direct current supply [Figure 4]), modifying it in such a way that the voltage applied to the electrodes was adjustable and pulsating. From his observations, Rodolfi deduced that the faradic induction devices (Figure 5), on which the aforementioned Duchenne had already worked, had to be replaced by galvanic batteries. Rodolfi's apparatus, which had galvanic batteries, had specific electrodes made with cushions of leather or cloth soaked in a saline solution (Figure 6). With regard to energy and time of exposure, Rodolfi formulated an opinion assuming that there were predisposed individuals in which "just a mediocre current applied for a quarter of an hour" was enough.[9] On the other hand, according to Rodolfi, in a minority of patients, the electrical anesthesia had to be necessarily preceded by "preparatory acts" with the administration of opium. The author suggested a kind of electrical premedication.[9] Rodolfi stated that male patients were less susceptible to anesthesia, but in females with a "nervous temperament, the hysterical ones or those who suffer from nervous alterations of respiration, [the electricity alone] provide the security of the result."[9] Although later Rodolfi admitted that he was able to obtain anesthetic effect in only 6 of 91 patients, the results seemed quite promising.[10] Rodolfi perfected his technique, describing the anesthesia of a single limb through the electric current. This method consisted

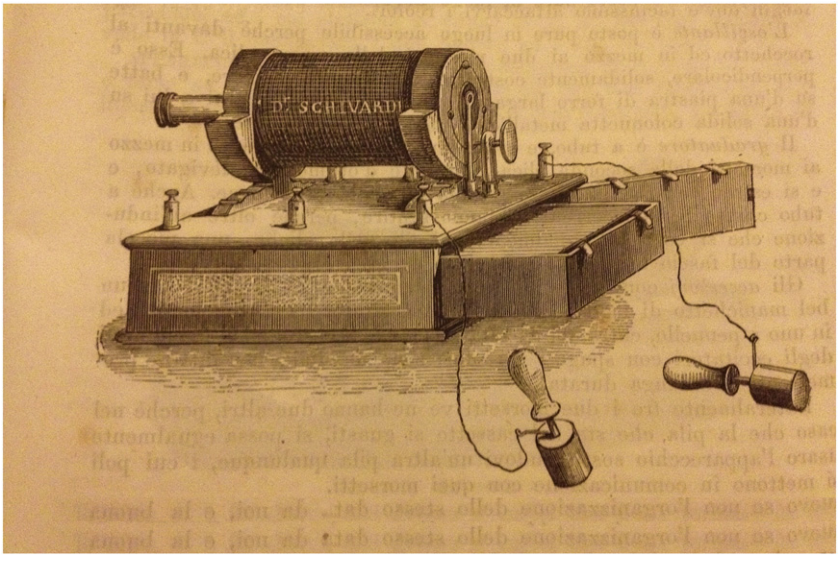


**Fig. 2.** Schivardi's apparatus for electrotherapy (built by Baldinelli, Milan, Italy). The coil, lying on two supports, has two propellers: one internal and the other external. The pile (bisulphate of mercury) is contained in the tray in such a way as to avoid damage due to any leakage of the corrosive substance. The oscillator is placed in front of the coil. There is an indexer voltage brass tube to change the voltage according to need. The Schivardi apparatus' special feature is the assembly of the various components and its small size (15-cm width, 14-cm height).