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## The history of electrotherapy of pain – or: what Voltaren® has to do with voltage

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To reasons not yet completely understood, the pharmaceutical trademark Voltaren® or Voltarol® refers to the Italian scientist Alessandro Volta (1745–1827) who played an important role in the history of electricity. It is shown that electrotherapy has been used for the treatment of pain, gout and rheumatic disorders from ancient times to the present day. This therapeutic attempt was also discussed in scientific literature in the late 1960s, the time Voltaren® was under development. Therefore, it is suggested that the electrotherapy of pain in history is a background for choosing this trademark.

### 1. Introduction

Branding of pharmaceutical products has always been influenced by a variety of factors including strategic planning, marketing considerations, advertisement purposes or linguistic aspects. Medical history, however, reveals several examples of trademarks born out of the intuition of a single person or developed with a merely anecdotal background. Thus, the story goes that barbituric acid has either been named after the inventor's girl-friend, Bar-

bara, or because it was synthesised on St. Barbara's day. Moreover, the fact that its sedative effects were first tried during a journey to Verona, Italy, is said to be the reason for the trademark Veronal® [1]. The exact reasons for branding a product in a particular way usually remain unclear as it is the case with Voltaren® (or Voltarol®), a pharmaceutical product containing the widely used non-steroidal anti-inflammatory compound diclofenac. Diclofenac was synthesized in 1965 based on theoretical considerations of structure-activity relationships by Alfred R. Sallmann working with CIBA-GEIGY, Basel, Switzerland [2]. It was first marketed 1974 in Japan as Voltaren®, and is now available in approximately 120 countries throughout the world. The company, now under the head of Novartis, admits that the brand not only sounds like being connected with voltage, volt and Alessandro Volta (1745–1827) but actually refers to the Italian scientist, father of the "Voltaic pile", the first battery-like apparatus for delivering a continuously flowing electrical current. Unfortunately, no one is able to remember the circumstances exactly and it is argued that the product was named after a street name ("Volta place") near the company [3]. This may be true; nevertheless it seems interesting to note that electricity and the treatment of pain and rheumatic disorders have always been associated with each other. Moreover, Voltaren is by far not the first trademark in history referring *expressis verbis* to the Italian physicist and recommended for complaints belonging to the symptom complex commonly referred to as rheumatic.

### 2. Electrotherapy of pain in history

According to Sidney Licht, Volta himself stated in a letter to the Italian physician Bassiano Carminati (1750–1830) dated April 13, 1803: "I have found the use of galvanism especially effective in rheumatic diseases, paralysis and weakened vision" [4]. The use of electricity for treatment of painful complaints, however, dates back



Fig.: Alessandro Volta (1745–1827) and the Voltaic pile (Courtesy of the Bakken Library, Minneapolis)

to antiquity. According to the Roman writer Scribonius Largus (approx. 50 A.D.), live black *Torpedo* fish were placed under the feet of patients standing on a moist shore washed by sea water. The electric shock inevitably delivered was said to cure pain, headache or gout. Other Greek, Roman and Arabian authors recommended “electroichthyotherapy” for treatment of headache, arthralgia, gout, migraine, melancholy or epilepsy and several other complaints including anal prolapse [5, 6]. From the Parthian dynasty approximately the same time, battery-like artificial devices (Parthian galvanic cells) are known which are said to have been used for analgesia similar to electric fish [7].

Electrotherapy started to be widely used from the middle of the 18<sup>th</sup> century after the Leyden jar came into use and in particular after the famous experiments done by Luigi Galvani (1737–1798) which led to the concept of animal electricity based on the hypothesis that electric energy is the stimulus behind nervous functions [8]. Not surprisingly, paralysis became the predominant indication for electrotherapy but in addition, complaints unprecisely summarized as “rheumatism” have always played a major role. In the 19<sup>th</sup> century, electrotherapy began to be accepted in academic medicine which may be seen from the fact that in 1836, Guy’s hospital, London, established its own electrical department under the supervision of Golding Bird (1815–1854) who soon became the leading advocate for this kind of treatment in Britain [9]. He reported several cases of successful treatment of affections connected with rheumatism, a term which was, however, not exactly defined at that time and intertwined with arthritis, gout, rheumatic fever and other complaints [10]. Thus, he reported cases of “chorea following rheumatism” and many others of paralysis, which was in his opinion caused by several situations and underlying diseases including exposure to cold and rheumatism [11]. Rheumatism was indeed regarded a main reason for paralysed limbs, one of the predominant indications for electrotherapy. Bird reported having successfully treated many such patients including those suffering from “rheumatic paraplegia” [12].

In the early 19<sup>th</sup> century, electricity-related speculations on the mechanism of pain relief began to arise when J.-B. Sarlandière and L. V. J. Berlioz started experimental treatment using a combination of acupuncture and electrostimulation. Berlioz stated that a galvanic shock produced by a Volta pile heightens the medical effect of acupuncture. “Electropuncture” was particularly recommended for the treatment of rheumatism, “nervous afflictions” and gout [13].

Electrotherapy of pain was continued during the 19<sup>th</sup> century as can be seen from many sources. For example, New York physician William James Morton (1845–1920) reported a variety of cases describing the successful treatment of muscular, fascial and articular rheumatism, chronic rheumatic pain associated with stiffness in both shoulders [14]. In an 1899 publication he spoke – more precisely in today’s terminology – of locomotor ataxia and rheumatoid arthritis [15]. In 1904, the British radiologist Francis Howard Humphreys (1866–1947) gave an overview of electrotherapeutic practice at that time. Among the indications, gout, lumbago, muscular, acute, subacute and chronic rheumatism as well as rheumatoid arthritis are mentioned in the first line [16]. Surgeon Robert Froriep (1804–1861) was one of the German protagonists; he wrote a volume dealing exclusively with rheumatic diseases and their electrotherapy [17].

### 3. Therapeutic agents and devices referring to Volta

The best way how to deliver electric energy to the body was heavily debated throughout the 19<sup>th</sup> century after the invention of the Voltaic pile had facilitated the delivery of a continuous flow of current. Volta’s “battery” consisted of different metal plates surrounded by a conducting liquid. Based on this principle, bimetallic devices were constructed in order to deliver electric energy after contact with liquid including human sweat [18]. One of the most famous devices of that kind was recommended as an “ingenious modification of the Volta’s pile” by “opinion-leader” Golding Bird: the “portable hydro-electric voltaic chain battery” invented by the Austrian Isaac Louis Pulvermacher (1815–1884) [19, 20]. The chain consisted of 50 to 100 elements. Each was made up of a wooden core around which were wound two wires, one of zinc and one of copper. Before being used the whole chain was immersed in vinegar whereupon the device evolved a current of decreasing intensity which was present as long as there was any liquid between the wires. Bird reported on exciting success in paralytic patients [19]. The following years saw many different kinds of “batteries” to be worn on the body surface and the borderline between science and quackery is hard to draw in retrospect. Among them, we find “Boyd’s battery”, “Richardson’s magneto-galvanic battery”, “Goldbergers chains”, the “Volta-electric brush” and many others comprised of two or more metals supposed to produce galvanic electricity when in contact with liquids and sweat. Claims for indications regularly include paralysis, rheumatism and neuralgia, but also heart, nerve and blood diseases [20, 21]. Some of them were explicitly called “rheumatism-chains” or “gout-chains” [22]. A variety of bimetallic devices in different shapes were to be worn as amulets [23] and some explicitly refer to Volta in their names. In the 1890s German Paul Strube and Adolf Oppenheim marketed so called “Volta-pendants” formed like a cross or a clock, respectively. Both were advanced developments of a Danish construction made by a Professor Heskier from Copenhagen. Strube’s and Oppenheim’s devices were – under optimum conditions – able to deliver a maximum current of 0.78 and 0.9 Volt, respectively [24]. The “Volkreuz” consisted of two metallic plates, one made of copper and one made of zinc, separated by a piece of red flannel and wrapped in yellow silk [25]. As late as 1933 a galvanic battery was advertised by a company called Wohlmuth-Monopol-Vertrieb, Frankfurt, Germany as a home-cure against gout, rheumatism, lumbago and several other diseases [26]. They claimed that unhealthy conditions were mainly caused by a loss of electrical energy from the body which was regarded as working like a battery; not an uncommon viewpoint in history as well [27].

A different attempt to cure rheumatism was to wear iron splinters mounted on pasteboard below the feet which obviously should work like a lightning-rod and were therefore called “rheumatism-rods” [28]. A patent medicine called “Volta-Powder” was similarly used by spreading it in the socks. Other than the name there were no claims of electrical properties, but again, it was supposed to cure rheumatism, gout and lumbago after having been absorbed through the sole of the foot. The manufacturer named the Volta Company, Philadelphia, claimed the product could eliminate excess uric acid from the body [29].

In conclusion, it can be shown that there have been close relations between the treatment of rheumatoid symptoms

and electricity from antiquity to recent times, whether or not the therapeutic agent actually delivered any current. In general, the history of “electrical analgesia” spans a time-frame of more than 2.000 years from antiquity to the present day including attempts of iontophoretic drug delivery [30, 31]. As late as 1967, Science Magazine reported successful attempts to control chronic pain by electrically stimulating sensory nerves based on the so called “gate control theory of pain” [32]. This was exactly the time, diclofenac was developed as a powerful analgesic and antirheumatic drug which was marketed as Voltaren® (Voltarol®) some years later.

What actually inspired the fathers of Voltaren to use this name and if they were aware of history and current attempts to achieve “electroanalgesia” may remain a secret; anyway, they continued a very old tradition. As it has recently been shown that therapeutic implications of applying electrical and magnetic fields to heal disease has always captured popular imagination to a remarkable extent [33], this might also be regarded as a subtle kind of marketing.

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