

## REVIEW

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# Physiology of Penile Erection—A Brief History of the Scientific Understanding up till the Eighties of the 20th Century

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### ABSTRACT

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**Introduction.** Understanding the physiology of penile erection is important for all who work in the field of sexual medicine.

**Aim.** The aim of this study was to highlight and analyze historical aspects of the scientific understanding of penile erection.

**Methods.** (i) Review of the chapters on the physiology of erection out of the author's collection of books dealing with male sexual functioning published in the German, French, Dutch, and English language in between 1780 and 1940. (ii) Review of the topic "physiology of penile erection" of relevant chapters of *Classical writings on erectile dysfunction. An annotated collection of original texts from three millennia*, including the study of all relevant references mentioned in these books.

**Main Outcome Measure.** The main outcome measure used for the study was the scientific understanding of the physiology of penile erection.

**Results.** In Antiquity, Galen considered penile erection as the result the accumulation of air. His ideas so dominated medieval medicine that nearly everyone then alive was a Galenist. The beginning of the Renaissance shows meaningful examples of experimental scientific work on the penis. Da Vinci correctly concluded that erections were caused by blood, and in the 18th century, Von Haller from Switzerland was the first who explained that erections were under the control of the nervous system. In the 19th century, a mindset that emphasized on experimentation determined a new direction, namely experimental physiology. Animal studies clarified that stimulation of the nervi erigentes-induced small muscle relaxation in the corpora cavernosa. Nearly all were published in the German language. That may be one of the reasons that the existence of the concept of smooth muscle relaxation remained controversial until the first World Congress on Impotence in 1984 in Paris.

**Conclusions.** As the Renaissance's innovative research defined neural and vascular physiologic phenomena responsible for penile erection. The concepts from animal experimentations in Europe in the 19th century significantly contributed to the current understanding of penile erection. **van Driel MF. Physiology of penile erection—a brief history of the scientific understanding up till the eighties of the 20th century. Sex Med 2015;3:349–357.**

**Key Words.** History; Physiology; Penile Erection

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### Introduction

**H**uman physiology investigates the mechanisms that keep our bodies alive and functioning. The principal level of focus is at the level

of organs and systems within systems. Understanding physiology is one of the basic prerequisites for practicing physicians. In this respect, the mechanisms of penile erection are important for all who work in the field of sexual medicine.

Today, we know that penile erection is a complex physiologic process that occurs through a cascade of neurologic, vascular, and humoral events. This cascade is initiated by auditory, visual, and olfactory signals and local stimuli of the penis. Erection begins with an increased flow in the pudendal arteries and dilatation of the cavernous arteries and helicine arterioles in association with relaxation of the smooth muscles of the trabecular network causing engorgement of blood in the corpora. This leads to compression of subtunical venules by the resistant tunica albuginea. This knowledge is common sense in the 21st century, but one should realize that current understanding of penile physiology has gone through a long evolutionary process. The goal of this article was to summarize and to analyze how the knowledge on the physiology of the penis developed throughout the ages, from Antiquity when the Greeks taught that erection was inflation of air up to the eighties of the 20th century.

### Antiquity and the Middle Ages

The study of human physiology as a medical field dates back to the time of Hippocrates (c. 460–c. 370 BC). His intellectual legacy pervaded Western medical thinking until the Renaissance. He stated that erections were generated *pneuma* and *vital spirits* flowing into the penis. In this respect, a proper balance between the four humors, blood, phlegm, yellow bile, and black bile, and the four elements, earth, air, fire, and water, was very important. Hippocrates thought that the testes were connected to the penis by fine cords, like a system of pulleys that could facilitate erection. Damage to these cords, for example by castration, would profoundly affect erectile capability [1]. As in his opinion, semen was the most potent fraction of male bodily fluids Hippocrates also believed that excessive ejaculations could reduce erectile functioning.

Ancient Greek philosopher Aristotle (384–322 BC) stated that penile erection was an “involuntary movement,” which could be caused by imagination [2]. As Hippocrates, he outlined the physiologic concept of the necessity of *pneuma* and he theorized that weight behind the testicles could raise the penis, so they acted as a sort of fulcrum. Charis Asvestis briefly summarized Aristotle’s thoughts on the physiology in one of the chapters out of *Classical writings on erectile dysfunction* [3]:

The erection of the human penis occurs through three mechanisms: 1. Imagination, 2 moisture, which

increases in the genitals whose passages are full of *pneuma*, and 3. The testicles, which act as a fulcrum.

Without any doubt Galen of Pergamon (129–200/216) was the most famous of the ancient physicians after Hippocrates. Galen’s job at a gladiator school early in his career gave him ample access to body wounds in humans, but his medical treatises were for the most part based on classic metaphysics and the dissection of animals [4].

In Galen’s view, the primary cause for erection was a specific quality of the corpora cavernosa (CC). He called them “the hollow nerves.” They were able to attract the expanding *pneuma* with the aid of connected parts consisting out of arteries, veins, and nerves, and in addition the “internal heat” pushed the penis out from a man’s body [5]. Many short case reports can be found in the work of Galen. Thirty-three are dealing with urologic organs or symptoms, seven specifically with the physiology of priapism. In his treatise *On the Affected Parts* Galen gave a sober description: “an increase in the length and circumference of the male genitalia without sexual desire and without the acquired increase in heat which some people experience in the recumbent position” [6]. In his view, priapism was the consequence of a nonnatural condition of the arteries presenting pathologic widening of arterial orifices or in the formation of gaseous *pneuma* in the nerves. According to Foucault, Galen was most often inclined to blame the dilation of arteries: “This kind of disease was found in those who had too much sperm and who contrary to their usual habits abstained from sexual intercourse (unless they found a means of dissipating in numerous occupations the surplus quantities of their blood), or in those who, while practicing self-control, imaged sexual pleasures after seeing certain spectacles or, as a result of recurring memories” [6].

With respect of Arabian medicine, the famous Avicenna (980–1037) was like Aristotle more a philosopher than a physician. While Arab physicians were not allowed to dissect human bodies, their ideas were over all nothing more than summaries of Galen’s work. Obviously, examinations of passages dealing with the physiology of erection in his book entitled *De Anatomia Testicularum et Vasorum Spermatis* confirmed the Greek ideas that erection occurred by filling with *pneuma* [7,8].

### The 15th–18th Century

One of the first people to study the penis thoroughly was Leonardo da Vinci (1452–1519)

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