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Key Points

- The discovery of and handling of cryogens with sufficient low temperatures made possible the destruction of tumors.
- The modern history of cryosurgery started in the physical chemistry laboratories and later developed with the expert contribution of engineers and physicists engineers, physicists and physicians.

1.1 Introduction

Human beings have always been obsessed with controlling extreme temperatures and apparently all for one purpose: eating. At one end of this thermal spectrum, man's discovery of fire marked a crucial turning point in human evolution. For some authors, cooking made man [1]. Control of fire allowed man to cook and feed himself with new products to nourish his body and mind. Control of cold helped humans with food preservation: there is evidence in ancient China and India that man knew how to preserve ice. But then ice got into the medical cabinet. It has been the oldest analgesic and anti-inflammatory treatment, back even to the times of the Pharaohs and the ancient Greeks. An Egyptian papyrus document describes the use of cold as an anti-inflammatory, and Hippocrates, back in fifth century BC, recommended cold for reducing bleeding, bruising, and swelling [2]. Ice was known as a cooling agent for many centuries,

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but low temperatures had to be controlled. In the ninth century, the Tang dynasty used potassium nitrate (saltpeter) mixed with sulfur and coal to make gunpowder, while saltpeter and water were combined to create a cooling agent. The Spanish physician Blasius Villafranca in his “Methodus refrigerandi ex vocato sale nitro vinum aquamque” [3], published in 1550, uses the word “refrigerant” for the first time, mentioning some of its uses.

However, if cold was to be used to cure diseases, lower temperatures were needed. This marked the beginning of the cold race: the quest for the perfect refrigerant had begun.

1.2 When Ice Met Salt (-20°C): Arnott, the First Crusader of Cryosurgery

The first record of a formal medical application of controlled freezing to destroy tissues is found by James M. Arnott (Scotland, 1797–1883), an

English physician who used a technique that allowed him to reduce tissue temperature to the proximity of -20°C . Between 1819 and 1879, he published on the use of cold as a medical treatment [4, 5]. Arnott designed his own cold equipment that used a mixture of crushed ice, water, and salts as refrigerant. He placed a waterproof bladder in contact with the lesion, while two hoses circulated the freezing fluid in and out of the bladder with the help of a pump. Incredible as it might sound, this medical invention was exhibited by Arnott at the 1851 Great Exhibition of London [6] where he won a prize medal (Fig. 1.1). He wrote that very low temperatures would stop any inflammation process as long as it was kept in close contact with the cold source for a long enough period of time. Although he started using cold for palliation of tumors, he ended up using it for many skin, breast, and uterine cancers; he was afraid of the pernicious side effects of chemicals used as early anesthetics and preferred the anesthetic power of cold for reducing pain.



Fig. 1.1 General view of the Great Exhibition of London of 1851, where Arnott received the prize medal for original equipment that allowed reducing tissue temperature to -20°C (Source: http://upload.wikimedia.org/wikipedia/commons/e/cb/Crystal_Palace_interior.jpg. With permission of collections.vam.ac.uk. Artist: McNeven J. Lithographer: William Simpson. The transept from the Grand Entrance, Souvenir of the Great Exhibition. Publisher: Ackermann & Co: 1851)

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