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History of cryotherapy

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Abstract

Cryotherapy refers to the use of cold temperature to treat disease and is a mainstay therapeutic modality for a wide variety of skin conditions. This article reviews the early history of development of cryotherapy in dermatology.

The Egyptians used cold to treat injuries and inflammation as early as 2500 BCE. Dominique-Jean Larrey, Napoleon's legendary surgeon, used it to facilitate amputations during historic retreat from Moscow [**1**]. Between 1845 and 1851, Dr. James Arnott of Brighton, England, described the benefits of local cold application in the treatment of numerous conditions, including headaches and neuralgia. Arnott used salt solutions containing crushed ice at a temperature of -18° to -24°C to freeze breast, cervical, and skin cancers; he observed shrinking of the tumors and significant decrease in pain [**2**]. He went on to design an apparatus for the application of cold that was shown at the Great Exhibition in London in 1851 [**3**]. However, the device was cumbersome to use, had little freezing capability, and had limited applicability. In addition, Arnott recognized the analgesic benumbing effect of cold, recommending its use to anesthetize the skin before surgery [**2**, **3**, **4**].

In 1877 Cailletet of France and Picet of Switzerland began development of an expansion system for cooling gases [**5**, **6**]. In 1892 James Dewar of Great Britain designed the first vacuum flask, which facilitated storage and handling of liquefied gases. Von Linde of Germany went on to establish commercial liquefaction of air in 1895-1896 [**7**]. The first clinical application of liquid air (-190°C) was in 1889 by a New York City physician, Campbell White, who used either a swab, a spray, or a brass roller device. He reported the use of liquid air for the treatment of diverse skin conditions, including lupus erythematosus, herpes zoster, chancroid, warts, and epitheliomas [**8**, **9**]. In 1907, Whitehouse, also from New York, reported a series of fifteen skin cancers treated with cryotherapy with good results. He described the use of a spray bottle, although he found this technique difficult and stopped using it in favor of a cotton swab [**10**].

Solidified carbon dioxide (-78.5°C) was introduced into clinical use by Dr. William Pusey of Chicago. He favored the use of solid carbon dioxide, which was commonly used as a refrigerant at the time and could be obtained where soda-fountain supplies were sold. Pusey treated warts, vascular nevi, lupus erythematosus, lupus vulgaris, and epitheliomas [**11**]. Further to these initial reports, many physicians made use of the freezing techniques in dermatology. After 1910, liquid air was seldom used, and solid carbon dioxide was the most popular cryogenic agent in the early 1900s.

Liquid oxygen (-182.9°C) came into clinical use in the 1920s. Irving and Turnacliff described good results with warts, lichen planus, and other skin conditions. Though it was readily available in the following years, liquid oxygen was hazardous because it was combustible [**12**]. In 1948 Kile and Welsh wrote one of the last reports on the use of liquid oxygen in a case series of over 1,000 patients with a variety of noncancerous diseases and mucosal diseases, including warts, hemangiomas, keratoses and leukoplakia [**13**].

Following World War II, liquid nitrogen (-196°C) became commercially available. In 1950 this cryogen was introduced into clinical practice by Dr. Ray Allington, who described the technique of using cotton swabs dipped in liquid nitrogen for the treatment of a variety of nonneoplastic skin diseases. Subsequently, this method became common practice for the treatment of verrucae, keratoses, and diverse other nonneoplastic lesions [**14**].

Modern cryosurgery began through the collaborative work of a physician, Irving Cooper, and an engineer, Arnold Lee [**15**]. They built a cryosurgical probe that became the prototype from which every subsequent liquid nitrogen cryosurgical probe was built. Made of three long concentric tubes, the probe was supplied with liquid nitrogen from a pressurized source. The inner tube served as a conduit for liquid nitrogen flow to the tip of the probe, while the space between the inner tube and the middle tube provided a path for the return of gaseous nitrogen from the tip of the probe. The space between the outer tube and the middle tube was vacuum insulated and had a radiative shield, allowing the liquid nitrogen to be conducted without heat loss to the tip of the probe [**15**].

Between 1961 and 1970, other cryosurgical apparatuses were developed using liquid nitrogen and other cryogenic agents, including nitrous oxide, carbon dioxide, argon, ethyl chloride, and fluorinated hydrocarbons [**16**]. Douglas Torre, a dermatologist, used Cooper's apparatus for skin diseases, developing a nitrogen spray device that could also be used with cryoprobe tips of various shapes and sizes, converting the conduit line to a closed system in 1965 [**17**]. In addition to benign lesions, Torre treated many types of basal and squamous cell carcinomas with cryosurgery. In 1967 Setrag Zacarian introduced a hand-held self-pressurized device [**18**]. Working with an engineer, Michael Bryne, he reported the development and use of a handheld spray device using liquid nitrogen in 1968. After some modifications, this became the first commercially available handheld cryosurgical device. Zacarian published his research and clinical data in a 1969 monograph and in two subsequent books [**19**, **20**]. In 1988 Torre, Lubritz, and Kuflik coauthored a book on the practical aspects of cryosurgery in dermatology [**21**]. Over the recent years, cryotherapy has become a well-established treatment modality for a wide variety of benign and malignant skin lesions, with novel uses continually described.

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