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Cryosurgery

By Emily Ptasnik, DO, and Chiara Rosenbaum, DO, MS

General principles

- Cryosurgery is a minimally invasive technique that utilizes subzero temperatures to destroy benign, premalignant, and malignant lesions.
- Cryosurgery should not be performed without first establishing correct diagnosis via clinical examination, dermoscopy, and/or histologic examination.

Mechanism of action

- **Extracellular dehydration**: Results from formation of ice crystals in *extracellular* space → water leaves the cell due to hyperosmostic gradient and cells become dehydrated.
- **Membrane rupture**: Occurs from continued freezing → water left inside the cell is frozen and the resulting intracellular ice crystals cause the cell to burst.
- **Vasoconstriction**: Results from initial freezing → further cell damage through anoxia.
- **Vasodilation**: After thawing, compensatory vasodilation releases harmful free radicals into affected tissue → additional tissue damage.

During thaw cycles, ice crystals reorganize inside the cell and form larger crystals with potential for more cell destruction. Water also moves from outside to inside the cell, resulting in cell swelling. Therefore, additional freezing causes further cell damage.

Indications for cryosurgery

Benign lesions	Warts, molluscum, seborrheic keratosis, hypertrophic lichen planus, prurigo nodularis, chondrodermatitis nodularis helicis, sebaceous hyperplasia
Premalignant and malignant lesions	Actinic cheilitis, actinic keratosis, Bowen's disease, keratoacanthoma, basal cell carcinoma, squamous cell carcinoma

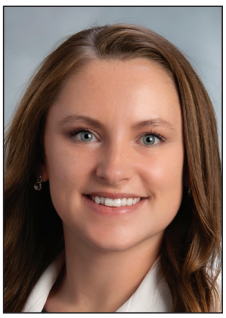
Contraindications for cryosurgery:
Cold urticaria, cold intolerance, cryoglobulinemia, and other cold-triggered conditions

Advantages	Disadvantages
• Safe procedure • Versatile – treats many conditions and can treat any area of body • Minimal work/sports restrictions • Excellent cosmetic result • Damage to surrounding structures is predictable and can be limited, with the preserved underlying stroma providing a structural framework for wound repair	• Hypo- or hyperpigmentation, especially in darker skin types (due to destruction of melanocytes) • Longer healing time with deep freezing (second intention healing required) • Scarring can lead to retraction at free margins • Possible alopecia with deep freezing of hair-bearing areas • Caution of underlying superficial nerves

Cryoanesthesia: Cryogens applied to skin can be used as an anesthetic — helpful technique for needle phobic patients and can be used prior to removal of benign lesions

Adverse effects

- Edema
- Vesicle or bulla formation
- Exudate
- Redness
- Pseudoepitheliomatous Hyperplasia
  - Disappears spontaneously after few months
- Tissue sloughing
- Eschar
- Hypopigmentation (can be permanent)
- Nail dystrophy
- Secondary infection
- Milia
- Scarring
- Alopecia
- Notching of ear or ala of nose



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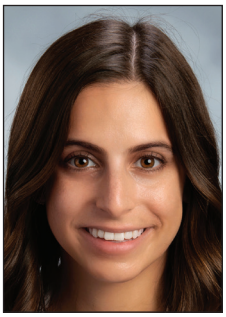

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Temperature required for cell death

Cell type	Temperature
Melanocyte	-4 to -5 ° Celsius
Keratinocyte	-20 to -30° Celsius
Fibroblast	-35 to -40° Celsius

Benign	-25° Celsius
Malignant	-50° Celsius

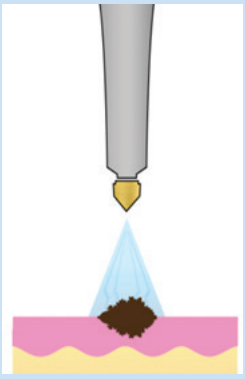
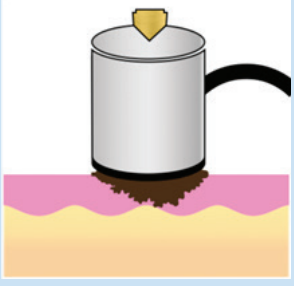
Optimal Freezing Techniques

Fast freezing	Intracellular ice formation and cell destruction better than slow freezing.
Slow thawing	Greater probability of ice formation within the cell. Thaw time is ~2x as long as freeze time.

Specific cryogens

Liquid nitrogen (LN)	• Boiling point -196° Celsius • Coldest • Most Common
Solid carbon dioxide	• Boiling point -79° Celsius • Sometimes used for chemical peels
Liquid nitrous oxide	• Boiling point -90° Celsius

Instruments and techniques

Instrument	Mechanism of delivery	Details	
Open (spray)	Metal container with spraying tip or opening through which cryogen is released Key factor: Achieving correct freezing temperature Discharge spray at a distance of 1-2cm from lesion	Most common Suitable for flat/elevated and benign or malignant lesions.	
Semi-open (confined spray, cone)	Using a non-conducting material with hole or cones to restrict spray of liquid nitrogen (LN) Splattering of LN avoided and normal surrounding tissue is spared	Faster freezing than the open technique.	
Semi-closed (chamber)	One end of metal cone is attached to cryogen Distal end is held firmly against skin (with rubber-protection) System generates potent freezing – turbulence within chamber → faster freeze time	Reserved for malignancies.	

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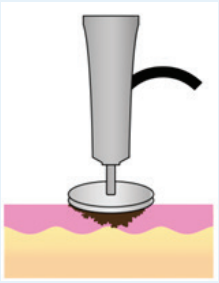
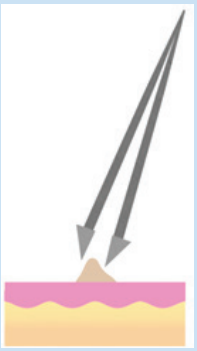
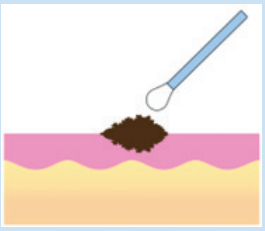
Instruments and techniques			
Instrument	**Mechanism of delivery**	**Details**	
Closed (probe, contact)	Cryogen delivered through closed system, such as a metal probe Probes vary in size and shape	Best for flat lesions to ensure homogenized freezing Hemangiomas = apply pressure in order to "press out" blood and lower final temp.	
Tweezers	Previously frozen forceps used to grasp pedunculated lesions	Ideal technique for filiform lesions, with sparing of normal surrounding skin Minimizes post-treatment hypo- or hyperpigmentation.	
Intralesional	Cryogen injected through tissue via needle One end of the needle is attached to cryogen The other end exits the skin to allow for release of LN	Used for large nodular tumors Advantage = freezing originates from center of mass.	
Dipstick	LN-saturated cotton-tipped applicator placed directly onto lesion	Can be used for verrucae and solar lentigines.	
Slush	Crushed carbon dioxide solids are placed in disposable towel, dipped in acetone and lightly dabbed onto skin		

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3. Mariwalla K, and Leffel DJ. Chapter 9: Cryosurgery. *Primer in Dermatologic Surgery: A Study Companion*. 2nd Edition ed., American Society for Dermatology: 2011; 53-56.