Traditional Cautery: a Narrative Review on New Lights through Old Window

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Abstract

Background: Traditional cautery is a well-known healing practice used in many diseases in diverse cultures of the world since ancient times. Traditional practitioners and professionals continuously improved several structural and procedural perspectives of this practice over centuries. However, numerous modern cauteries and related devices used in modern surgery began to be developed by Bovie and Harvey in late 19th century. Objective: This critical review describes briefly modern cauteries (new lights) used in modern surgery that work on the same principles of traditional cautery (old window).

Methods: E-searches of relevant data (2000-2018) published in PubMed, MEDLINE, Google Scholar, Science Direct and OvidSP databases were made using the Boolean operators and keywords. Finally, 91 articles were retained for this narrative review.

Results: Several important components of traditional cautery were progressively developed and improved by traditional healers and professionals and this developmental process continued in modern surgery since 1988. Heating of traditional cautery by fire was replaced by electric current in innumerable modern cautery devices that generate variable energy power density for effectively destroying diseased tissue together with other related functions with minor adverse effects and complications.

Conclusion: Although electrocautery and electrosurgery units with wider applications in medical and other sciences use electric current in different ways to produce energy for cutting and removing the intended tissue in modern surgical settings around the world, traditional cautery mother of modern cauteries is still used by healers mainly in the eastern world. Both are associated with adverse effects and complications, and this perspective is calling for future research to rectify the associated technical snags in modern surgery.

Keywords: Traditional cautery, Electrocautery, Electrosurgery, Electrosurgical units, Adverse effects, Complications

Introduction

Cautery is a traditional healing practice used in many medico-surgical conditions since ancient times with variable efficacy [1-3]. Cautery similar to moxibustion in Traditional Chinese Medicine (TCM) has a checkered history and developed after the discovery of fire [4]. Fire is linked with healing power, and as a ritual also worshiped in certain cultures of the world [4-6]. Diverse olden cultures progressively developed and improved traditional cautery, its definition, procedures, and techniques with safety measures, shapes, forms, and materials other than fire such as oil and ligatures used in traditional cautery practice [1,2,4,7]. Furthermore, advancements were also made in identifying indications, contraindications, adverse effects and complications associated with cautery [1,2,4,6]. Though the research was in infantile phase during ancient times, published data collected through case reports, case series and traditional healers’ impressive observations over thousands of centuries helped significantly in the advancements of traditional cautery and cauterization process. This research landscape of ancient times has changed robustly over the past three decades or so. Many sophisticated rigor research supported by international health organizations are now conducted globally in complementary, alternative and integrative
Qureshi, et al. medicine. Research also contributed to the refinement of traditional cautery (old window) and its new lights in terms of modern surgical devices. Overall, traditional cautery is still used in many health conditions around the world by folk healers and professionals, and until now they remain the strong promoters of sustaining its cost effective safe practice.

Of special note, the Islamic doctrines and hadiths of Prophet Mohammad (PBUH) continued to support healing in three things including a gulp of honey, Hijamah and cautery. Due to certain reasons, Prophet discouraged the use of cautery by fire but never prohibited its practice in difficult-to-treat cases [8-10]. Although traditional cautery (Fig.1) is recommended as the last treatment, a variable number of patients first consult faith healers for cauterization in Eastern world and then conventional practitioners for their medical problems. This trend is vice-versa as well and, hence, traditional cautery will continue to survive in future. As our research team has comprehensively reviewed several perspectives of cautery [1-4], this article will focus mainly on new lights in terms of modern cauteries, which have their origin in traditional cautery (old window).

![Figure 1. Traditional Cautery (left) and electrocautery (Right) [11,12].](image)

**Aim of the Study**

The aim of this review is to analyze and synthesize concisely the pertinent literature on modern advanced cauteries and related devices used in diverse diseases in modern surgery, underlying working mechanisms, adverse effects and complications. The significance of this study is that it will support and scale up the precise practice of cautery along with a focus both on relevant research and training directed towards patients, traditional healers and health professionals. Furthermore, this narrative review will bridge the basic knowledge and treatment gaps of CAM practitioners and health professionals regarding various new versions of modern cautery. Another important point is that it is the first review of modern cautery from the Kingdom of Saudi Arabia. Notably, surgeons are well experts in using the electrocautery and electrosurgical units in everyday surgical practice; this critical review is primarily directed towards CAM practitioners who may benefit from it.

**Methods**

**Search Strategy**

The relevant literature published in English prior to 2018 was searched in PubMed, MEDLINE, Google Scholar, ScienceDirect and OvidSP databases. The Boolean operators and keywords used in multiple electronic searches were “modern cautery AND types OR working mechanisms OR devices OR electrocautery AND electrosurgery OR chemical cautery AND hand cautery OR steam cautery OR laser cautery OR cold cautery OR devices OR electrolysis OR electrosurgical AND electrocautery techniques AND procedures OR methods OR light cautery OR coblation OR cryotherapy OR branding cautery OR electrocoagulation OR electrosedication OR electrofulguration OR electrosection OR "adverse effects" OR "complications". The search strategy and the keywords were modified as appropriate according to the searched database. In addition, references included in full text articles focused mainly on modern cauteries were reviewed for inclusion in this review.

**Search Results**

Hundreds of thousands articles (n=36,748) were retrieved and reviewed by two independent researchers (NAQ & HAS). Our focus was on full articles describing modern cautery and its different advanced versions, methods, techniques and devices or units. In addition, we also reviewed articles that gave adverse effects and complications of modern cauteries. These articles were reviewed critically and the brief sketches of important contents were incorporated in this review. The additional inclusion criteria were free access to full articles, papers containing salient features of newer electrocautery and electrosurgical cauteries. All types of related studies such as systematic reviews and meta-analyses, randomized clinical trials, observational studies, case series and single case reports were included for reviewing. Screening of retrieved records excluded 33,679 papers. More than three thousands records were reviewed for eligibility purpose (n=3069). Consequently we removed duplications (n=1125), unrelated articles (n=1131), no abstract (n=272), articles cited in SR and MA (n=57), full articles not accessible (n=248), irrelevant information (n=360) and no focus on modern cauteries (n=109). Finally, both reviewers agreed to include 91 published studies. (Fig. 2).
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Results

Currently, many advanced forms of modern cautery and cautery device, i.e., new lights from traditional cautery (old window) are used in medicosurgical conditions [1,4] and each of them will be described briefly. However, a comprehensive review of how electrosurgical and electrocautery devices work in many conditions along with adverse effects and complications is available here [13].

Chemical Cautery

In the olden times, various chemicals in terms of corrosive materials, herbs-acidic or alkalis, drugs and boiling oils were used in traditional cautery that had several applications in many diseases [1,2,4,14,15]. This trend of chemical cautery continues but with the use of newer chemicals in the treatment of various medicosurgical diseases [16-18]. These chemicals include, but not limited to, silver nitrate, sodium hydroxide, tri-bi-chloracetic acid (90% bichloracetic acid), phenol and cantharidin. Various studies reported that cauteronization of the nail matrix (matricectomy) by 1-minute phenol is effective; however, bichloracetic acid has a better safety profile than prolonged applications of phenol in the treatment of ingrown nails [16,17,19]. Partial nail avulsion combined with matricectomy with bichloracetic acid is reported to have better results; minimal tissue damage, no drainage and faster healing [17].

Chemical cautery also uses silver nitrate that is effective in nose bleeds in children [20]. Overall, chemical cautery in which targeted tissue is damaged by chemical is used effectively in certain conditions in today’s surgical practice.

Hand Cautery

Hand cautery (or hand held cautery, handheld cautery device, handheld cautery pen), a modern version of traditional cautery is successfully used in many skin conditions including facial telangiectasias that involve superficial cutaneous vessels. In facial telangiectasias, treatment is performed by cautelization at 800°C (electric current generated energy), delivered via a 30G tip directly to the lesions for milliseconds [21]. Hand cautery, an inexpensive and safe technique, is associated with minor skin irritation and edema which resolve within 72 hours without any treatment intervention. Furthermore, curettage and cautery (first curetting the dead tissue or growth and then cautering) is effective in basal cell carcinoma but recurrence, an arguable subject, tends to occur even after excision [22,23].

The non-genital warts may be treated by a variety of medical and surgical interventions including salicylic acid and curettage or hand cautery. The success rates are variable (65% to 85 %), and scarring and recurrence occur in up to 30% of patients [24-27]. Scarring can be particularly problematic on the sole of the foot [28].

Overall, handheld cautery in unipolar mode uses electric current to produce energy to damage effectively the targeted tissue concerning mostly superficial skin diseases including cancers.

Actual Cautery

Actual cautery also used in olden times refers to the metal device heated in flame and then applied to damage tissue [14,15,29]. However, its use is integrated with other cauteries including modern cautery or chemical cautery in various conditions. In one case of snake bite, actual cautery (heating by fire) was combined with potassium permanganate (chemical) during the same session with rapid improvement and the patient regained consciousness without any pain [29].

Similar results were reported in another patient with snake bite who was treated only by actual cautery [30]. The actual cautery is a version of traditional cautery, and others like steam, thermal, chemical and electrocautery with special small devices using electric current and chemicals are used with good results in many superficial medicosurgical conditions including hairy moles, epithelioma, ulcer, lupus vulgaris and surgical contracepion (vasectomy) [31-33]. The use of electrocautery (advanced form of traditional cautery described below in detail) is questionably effective in coagulation and caesarean section-induced wounds [34].

Main Differences between Electrosurgery & Electrocautery

Electrocautery: Electrocautery, an advanced form of traditional cautery uses electric current to produce energy for damaging intended tissue. Electrocautery devises/units are all monopolar or bipolar operation, and details of their designs and working principles such as unipolar or bipolar "Bovie," a laser, a Harmonic Scalpel and LigaSure are available here [13]. There are significant differences between the two concerning the tools...
used and therapeutic application. Briefly, in unipolar electrocautery, electrical current is used to heat a metal wire—an electrode that is applied to burn or destroy or coagulate the targeted tissue. Conversely, the generation of high frequency current (100 kHz to 4 MHz) which induces ionic vibration is the main working principle of standard bipolar electrocautery devices with two electrodes. Bipolar energy is better for hemostasis, seals blood vessels, offers complete coagulation, less blood loss and less injury to the adjacent tissue. Notably, in electrocautery with one electrode having one tip electric current not passed through the tissue. There is another return electrode with grounding pad for completing the electrical circuit. The current passes through the body for a couple of seconds. The use of electricity and, hence, single heated electrode is classically applied in superficial lesions treated by surgeons. However, electrocautery device is typically small and battery operated which uses heated electrode to accomplish the desired goals. In unipolar electrocautery, the amount of heat generated depends on the size of contact area, power setting or frequency of current, duration of application, and waveform. A constant waveform generates more heat than intermittent. The frequency used in cutting the tissue is higher than in coagulation mode. More details about electrocautery and electrosurgery are available here [12, 13, 35,36,37].

**Electrocauterization Process:** Cauterisation is the destruction of tissues by heat, electricity, laser, freeze, or chemicals. Electrocauterization using electric current is commonly used to remove unwanted tissue or to achieve haemostasis. Common indications include viral warts, cherry angiomas, and sebaceous hyperplasia. Counselling the patient and taking written informed consent are mandatory before commencing the procedure. Relative contraindications include anaemia, diabetes mellitus, cardiac disease, cardiac pacing, hypertrophic scars and keloid, and hearing aid. After local anaesthesia, a small electrode is applied to the intended tissue/skin. A grounding pad should be applied to the patient’s thigh for protection from burn. The electrode has high frequency electricity current at its tip, and each cauterizing cycle does not usually last for more than a few seconds. Lesions such as viral warts or seborrheic keratoses may also be managed by first curettage followed by electrocauterization. Complications of electrocautery include injury to the neighbouring tissues, blood vessels and nerves, and scarring as healing by secondary intention, and interference with pacemakers and implantable cardioversion defibrillators [12,13,35-38].

The use of a fine tip for diathermy and the lowest effective electric power density tends to minimize scarring. With electrocautery, no specimen is available for histopathological examination and, hence, the surgeon must make sure about the diagnosis before electrocautery intervention [38].

In a related development, electrocauterization is preferable to chemical cautery because chemicals leak into and injure extended tissue and produce toxicity of the surgical smoke, the latter may harm both patients and staff. Further differences between electrocautery and electrosurgery are defined in the below section.

**Electrosurgery**

In electrosurgery, alternating electrical current that generate high frequency radio waves passes through the tissue to achieve a well-thought task. The typical frequency used in surgical operation is around 500,000 cycles per second. The alternating current with this radio frequency passes through the tissue but does not cause an electric shock. In fact, in electrosurgical procedure the heat/energy is created by the resistance of the tissue to the alternating electric current with aforesaid radio frequency. In electrosurgery, the several tools to which the current is applied are electrodes in terms of blade, round ball, needle and loop configuration, and they are selected in tandem with intended task and outcome. These instruments are often used to incise, coagulate, desiccate, fuse and fulgurate tissue or overgrowth [36,37,39]. In bipolar electrosurgery, the current passes through the tissue between the tips of two electrodes but not through the body and, hence, does not have any complications such as contamination, electric shock, and thermal burns observed in monopolar electrocautery (types –cut, coag and blend) [13]. The electrosurgical units (ESU) are more sophisticated radio-wave generators that pass modified electrical current through the target tissues to achieve the desired surgical results. Thus, electrosurgical procedure is more complex than electrocautery and lateral thermal injury is lesser in bipolar than unipolar devices.

**Electrosurgery Techniques:** The electrosurgery applies monopolar (Fig.3) and bipolar methods. Concerning monopolar electrosurgery, a complete electrical circuit consists of the electrode, patient, return electrode (grounding pad) and the electrosurgical generator. With the monopolar technique, the alternating electrical current passes through an electrode to the tissue until it reaches a grounding pad (return electrode) placed in proximity, another location on the patient’s skin. Typically, return electrode is placed on the opposite side of the body from the incision site. From return electrode pad, the energy finally returns to the ESU. Of note, power density following the law of Jules determines which effect predominates in the surgical field [13]. High-power
density produces more rapid tissue heating, intracellular water vaporization, cellular disintegration and explosion, and incision. Lower-power density does not allow the cell to heat to 100°C. In a cell heated to 60°C, the proteins denature forming a viscous coagulum that impedes blood flow called a "coag mode" [13]. The bipolar technique utilizes a forceps-style electrode with two tips. Most important, the electrical current travels from one tip to the other, and the targeted tissue is between them. The key difference is that monopolar procedure uses a grounding plate to direct the current and bipolar type employs opposing electrode tip to accomplish the same thing. Thus, monopolar and bipolar techniques of electrosurgery differ from electrocautery; electrosurgery draws alternating electrical current through the tissue but electrocautery uses electric current to heat an electrode to damage the tissue [38,39].

Complications: Electrosurgery with differing approaches and devices is not without adverse events which include direct misapplication, capacitive coupling, direct coupling, and insulation failure, leading to damage to adjacent structures and other unrecognized and identified injuries such as burns of patients and surgeons and bowels during laparoscopy surgery [40,41]. Surgical procedures and equipments are associated with 50% and 16% of adverse events, respectively [42,43]. Like traditional cautery [1,2], modern cautery techniques and devices are reported to contribute to a variety of aforesaid adverse events and complications. Although obvious advancements are made in conventional surgical cauteries, unfortunately adverse events associated with traditional cautery were not rectified in electrosurgical and electrocautery devices used in modern surgery. This is an important moot point when modern surgery is very expensive and also unsafe in light of old window.

Methods of Electrosurgery

Electrodesiccation: Electrodesiccation along with curettage (ED&C) is a commonly used method of electrosurgery [35]. This method associated with dehydration is indicated for nodular and superficial forms of basal cell carcinoma (BCC). Conversely, micronodular, recurrent, or morpheaform BCC requires excision with adequate margins because of the likelihood of deeper infiltration in the dermis [45,46]. The success rate of ED&C for BCC depends on the clinician’s skill with curettage. When using the curettage for BCC, the tumor’s physical consistency differs from surrounding healthy skin. Detect of subclinical extension of the tumor based on this physical consistency that will guide surgeon to obtain adequate margin usually 2-4 mm beyond the border. Reported recurrence rates range between 1.6% and 5.7%-18.8%, and this variability is attributed to methodological differences such as settings, skills of the operator and selection bias [48,47].

Electrofulguration: Electrofulguration and electrodesiccation both use markedly damped, high-voltage, low-amperage current with a single terminal to produce local tissue destruction. In electrofulguration, there is no direct contact of the unheated electrode with the skin and the result is superficial epidermal carbonization through sparks from the electrode, which is held 1-2 mm above the skin surface. The carbonization helps in the insulation of the underlying tissue and, thus, minimizes both deeper harm and so scarring. Conversely in electrodesiccation, the unheated electrode makes contact with the skin and results in superficial dehydration due to ohmic heating. The effect is mostly in the epidermis, and carries a minimal risk of scarring with hypopigmentation attributed to higher voltage linked with increase in depth of damage [38,48].

Electrocoagulation: Electrocoagulation procedure also applicable to electrocautery uses two electrodes; one makes contact with the skin and the other is an indifferent (return) electrode with grounding pad. This technique uses low-voltage, moderately damped, high-amperage current to cause deeper tissue destruction with minimal carbonization. Electrocoagulation also causes hemostasis of vessels less than 1 mm and for that a dry surgical field is required. The treatment electrode may then be applied directly to the vessel or by clamping the vessel with forceps and indirectly applying the current to the vessel by touching the treatment electrode to the forceps [38]. Thus, the collagen and elastic fibers are fused and hemostasis is achieved.

Of note, electrocoagulation technique through the use of bipolar forceps is suitable for stopping bleeding from small blood vessels during skin surgery. Electrocoagulation or diathermy

Figure. 3. Monopolar Electrosurgery [44]
coagulates tissue between two tips of electrodes, causing minimal thermal injury to surrounding tissues. Furthermore, the bipolar surgical unit continuously measures tissue impedance with the help of computer and automatically switches off the electric current when coagulation has occurred. Coagulation happens before desiccation (drying tissue) and fulguration (tissue destruction) \[40\]. Electrocoagulation keeps the tips of the forceps clean (no contamination) and also linked with time saving. Most bleeding vessels observed during derma surgery can be sealed, and only arteries with a diameter greater than 3mm need to be ligated \[50\]. Notably, bipolar coagulation and cauterity equipment neither interfere with pacemakers, intracardiac electronic devices, or artificial joints \[51\]. Thus, bipolar electrosurgery/surgical coagulation units associated with minimal or no complications are ideal for minor surgical diseases including of nails, skin, eyes, and ear, nose and throat with good results \[35,37,40,50,52\].

Electrosection: Electrosection also uses two electrodes (bipolar), i.e., treatment electrode and indifferent (return) electrode and low-voltage, high-amperage current. The effect on tissue depends on whether the current is undamped or slightly damped. Undamped electrosection results in cutting without coagulation, whereas a slightly damped current offers some coagulation. Overall, the effect is tissue vaporization with minimal adjacent tissue damage. A major advantage of electrosection is the ability to cut tissue while simultaneously obtaining hemostasis \[35\].

Electrolysis: Electrolysis is an electrosurgical modality, which uses a chemical reaction created by direct current to damage tissue. Depending on media to be electrolyzed and diseases under consideration, electrolysis with many versions such as hydro-electrolysis, percutaneous and bipolar electrolysis has wider implications in medicosurgical conditions such as hair removal and nonmedical sciences across the globe \[53-57\]. Overall, electrolysis with its innumerable types has numerous applications in medical and other sciences and is associated with minor complications, and also presents a number of threats to the safety of public health across the board.

Coblation

Coblation, an electrosurgery modality, is used in many conditions including removal of infected tonsils, and for cosmetic purposes such as facial rejuvenation. The coblation procedure name is derived from “controlled ablation”, which uses an electrical current (bipolar radiofrequency) to ionize a conduction medium such as isotonic saline. The ionized medium is then used to transmit heat to tissue dissolution. This procedure improves patients’ quality of life and associated with no complications \[35,58,61\]. Overall, coblation with its several versions based on conduction media is used effectively in many health conditions of children, adolescents and adults, reported to have nearly no complications and enhances their quality of life.

Light (gentle) Cautery

The light cauterity electric operated and another version of modern cauterity is reported to effectively cure closed-comedone naevus that affect primarily young population. In a case report involving 35-year old female with closed-comedone who tried unsuccessfully multiple therapies, two sessions of light cauterity combined with topical retinoid application (0.1% Differin cream) resulted in good outcome and improvement continued over 15-month followup. In this patient, the Thackray light duty cauterity and light transformer 240 V, 75vA with the V-shaped tip was used, and 30% of maximum output was applied. The tip of light cauterity did not glow but brown discoloration was observed when tip was touched on a paper. The cauterized area healed fully within 2-week with mild post-inflammatory erythema but no scarring. Though many treatments including oral contraceptive pill, surgical excision and manual extraction are used in closed- and open-comedones, light cauterity and topical retinoid bring about good outcome associated with patient satisfaction. Maintenance treatment with retinoid use at less frequency was not associated with any side effects \[62\]. In another case report of severe closed macro-comedones (1 to 3 mm diameter), Thomson and colleagues reported the success of light cauterity under topical/local anaesthesia. Comedones often co-occur with acne, which tends to flare up with retinoid given simultaneously with light cauterity \[63\]. Pepall and associates also reported about light cauterity to be effective in the management of white heads-larger comedones (1-2 mm in diameter) compared to oral treatment with retinoids \[64\]. Retinoids have a variety of reversible dose-dependent adverse effects (except bone abnormalities) which partially limit their use in diverse medical conditions including cancers, comedones, acne and psoriasis vulgaris \[65-67\]. Overall, light cauterity either alone or combined...
with retinoids is used effectively in many cutaneous conditions.

**Pulse-Dye Laser**

Laser (light amplification by stimulated electromagnetic radiation) cautery another version of modern cautery has many applications both in numerous health conditions including warts, granular pharyngitis, nose bleeds, rhinitis and hemangiomas and diverse industries [68,69,70]. For example a hemangioma involving different sites is often treated by multimodal therapy including medications, surgery, pulse-dye laser, topical and systemic corticosteroids, rapamycin inhibitors and propranolol. No significant difference in wound infection rates or scar cosmesis was identified between the treatment groups [69]. In advanced carcinoma of the breast, it is difficult to radically excise the tumor or infiltrated neighboring structures notably underlying muscles or bones. Thermal cauterization of the infiltrated cells through thermoablation as mentioned aforesaid tends to improve overall prognosis. Thermoablation, ultrasound-guided laser-induced modality is a very innovative treatment for the cure of breast cancer [71]. For the comprehensive details of breast cancer margin assessment using various optical techniques, this reference is invaluable [72]. In overall, like all modern cauteries laser cautery with its own several versions is used effectively both in various diseases including skin carcinoma and several industries.

**Plasmakinetic Cautery**

Plasmakinetic cautery is based on energy model derived from high grade radiofrequency. This surgical procedure (with 6 to 8 numeric set point range) ionizes the water vapor both in the air and in the tissue, which is the main underlying working principle [73]. Plasmakinetic cautery uses pulsed radiofrequency to generate a plasma-mediated discharge along the exposed rim of an insulated blade. Consequently, it creates an effective cutting edge while the blade stays near body temperature (50 degrees centigrade) [74,75]. In breast surgery, plasmakinetic cautery is used with good results compared to electrocautery. The advanced technique is atraumatic with a cutting precision, hemostasis, and rapid wound healing with minimal tissue injury. In addition, it reduces the drainage amount, duration time, adequate operation duration, and acceptable blood loss compared to electrocautery [73]. Overall, plasmakinetic cautery is comparable to electrosurgical procedures and works relatively better than electrocautery. Various forms of electrosurgical cauteries originated from traditional cautery are listed here (Fig. 4).

**Cryotherapy**

Cold cautery or cold therapy or cryosurgery (Greek word, cryo=cold, therapy=cure), all concern to a procedure that destroys tissue of both benign and malignant lesions by the freezing and re-thawing process (Fig. 5). Liquid nitrogen and carbon dioxide snow are the two commonly used freezing sources for cryotherapy. In addition, a low temperature instrument is used to cause destruction of tissue by freezing [76]. Now cryotherapy is used increasingly to treat many dermatological conditions in hospitals and primary healthcare practice. Indicated conditions include; (a) viral warts and molluscum contagiosum; (b) keratoses, both seborrhoeic and actinic; and (c) biopsy proved Bowen’s disease. A liquid nitrogen spray or a cotton wool dipstick method may be used to obtain equally good results. The best results are then achieved by “rolling your own.” In the technique, cotton wool bud is immersed in liquid nitrogen, and then applied firmly to the lesion. The practitioner should wait (5 to 10 seconds depending on the lesion size) until a thin “halo” (like white ring of ice) of frozen tissue has spread 2 mm out from the base of the lesion and this procedure may be repeated if required. Practitioners should take a number of precautions which include; 1) great care with lesions on the faces of children and with pigmented skins. Hypopigmentation and hyperpigmentation can occur; 2) before treatment make sure about the diagnosis by a confirmatory biopsy such as in Bowen’s disease;3) inform the patient about the possible formation of a hemorrhagic blister at the site within 24hours, which could be prevented by potent corticosteroid ointment application immediately after cryotherapy. If a blister is formed with pain, a sterile needle need to be used to burst it followed...
by a dry dressing; and (4) avoid treating lesions on both hands or feet at the same visit [76]. Further details of cryosurgery including indications, contraindications, advantages, disadvantages, devices and techniques along with its integration with other therapies are available here [76-78].

**Figure 5.** Cotton wool dipstick method (right) of cryotherapy with devices (left) [76,78]

**Branding Cautery**

Branding cautery, used mostly by traditional indigenous people for artistic, forced, recreational and self-expressive purposes, means the branding of a human by heated metal tip [6]. Currently, branding is a body art that involves third degree burn on the skin surface resulting in permanent scar. Branding is done using a variety of procedures and hot materials [79]. The process of branding now also common in western world is used in tattooing and piercing, which can also be done by electrocautery, laser, chemicals, and freezing. Like all forms of cauteries in modern surgery, branding produces a variety of complications such as acute infection, transmission of blood-borne diseases such as HIV and hepatitis B & C, allergic reactions, pain and bleeding, pigmentation, and keloids [6,79]. Other complications associated with skin branding performed using old and modern methods either in normal persons or individual with risk behaviors including substance abuse or with advanced diseases are reported to be hair loss, hyperkeratosis, acanthosis, squamous cell carcinoma, i.e., Marjolin's ulcer, foreign body reaction, oral and tooth problems, aspiration and hypoxia, edema and swelling [80-88]. Overall, branding including piercing and tattooing using different sources of burning tend to fulfill multiple purposes, but these procedures are associated with serious complications.

**Discussion**

This review mainly focused on modern cauteries which are originated from traditional cautery. Modern cauteries are used in today’s surgical practice around the world. According to Brodman, William Bovie did not invent traditional cautery, which was used by the Egyptians in 3,000 BC. However, Bovie and Harvey Cushing using the same principle of traditional cautery pioneered an electrocautery unit in 1880. Subsequently, a variety of electrocautery and electrosurgical units (ESU) with automation and computer assisted were developed that use direct or alternating electric current (low-voltage & high-amperage) to generate sufficient heat to cut through the tissue with coagulation or cellular denaturing or vaporization into atomic carbon [13,89,90]. Notably, the resulting effect concerning ESUs depends on the tissue, such as, direct application to tumor leads to destruction of tumor cells and application to vessels results in hemostasis. Electrocautery less sophisticated than electrosurgery is commonly used when high-frequency electrosurgery is contraindicated [35]. In a correspondence, Arya discussed the pros and cons of electrocautery/diathermy and electrosurgery compared with surgical scalpel with a focus on smoke plume; reduced tensile strength, an increased infection rate, a greater zone of wound necrosis, increased pain, less blood loss, smoke plumes with carcinogens and organisms hazards to staff and patients, and burn to surgeons may happen in both techniques [91]. In a systematic review and meta-analysis, no significant difference in wound infection rates or scar cosmesis was identified concerning electrocautery and cold scalpel [92]. Adverse effects and minor complications of these advanced surgical procedures need proactive prevention: contamination by using disposable electrodes, and electric shock and thermal burns strictly following the recommended guidelines and precautions by patients with pacemakers or wearing other metallic items. Aforesaid adverse effects are infrequent with bipolar electrocautery/electrosurgery because the electrical current from one tip of the forcep passes through the tissue to the other tip, and then back to the electrical generator and, hence, lesser chances of patient burns and other complications. Like electrocautery and electrosurgery, traditional cautery with its several versions also has more or less similar adverse effects and complications when used in most complex, potentially dangerous physical conditions by unqualified, untrained and inexperienced healers. Overall, based on the basic principles of ancient times, thousands of year's successful practice by healers and professionals make cautery a creditable therapy in the current holistic model of complementary and integrative medicine across the world [1,2,4].

Concerning efficacy of modern cauteries, only few snapshots of some important studies are described because full coverage of all research concerning electrocautery or electrosurgery is beyond this narrative review. A systematic review
and meta-analysis found six eligible RCTs for comparing cold scalpel with electrocautery (modern cautery). Electrocautery significantly reduced the incision time and postoperative wound pain. A trend toward less incisional blood loss from skin incisions made with electrocautery was also noted. Electrocautery is a safe and effective method for performing surgical skin incisions [92]. Similar results related to electrocautery were reported regarding skin incisions in neurosurgery procedures without any complications [93]. In one study, topical anaesthesia EMLA cream (lidocaine, 2.5% and prilocaine, 2.5%) was found to be effective in controlling pain while thermocautery was used to surgically remove genital warts [94]. Furthermore, renal cell carcinoma tends to produce skin metastasis heralding poor outcome and imminent death. For these bleeding lesions, the patient often refuses radiotherapy, and seeks electrocautery to control hemostasis effectively [95]. Bipolar high frequency electrocauterization followed by daily moist-wound-treatment with polyacrylate hydrogel with pharmaceutical sodium chloride is reported to better improve wound healing in cutaneous leishmaniasis compared to controlled group [96]. Overall, modern surgical procedures using electrical energy are effectively used to perform a variety of functions in medical and surgical diseases with minimal adverse effects and complications.

This narrative review has some limitations. This paper is not a systematic review and not very comprehensive. Selection and publishing biases are quite obvious. These caveats are because of related literature on modern surgical devices and tools, techniques, applications and indications is too huge to incorporate into this critical review. The strengths of this review are; 1) this is the first review from Saudi Arabia; 2) it is directed towards complementary and alternative (CAM) practitioners across the globe; 3) this review highlights the basic principles of modern cauteries (new lights) that have their origin in ancient traditional cautery, old window, and have wider clinical applications including diagnostic not only in surgical practice but also innumerable industries. Like traditional cauteries, modern electrosurgical units and procedures are associated with various adverse effects and complications, and this perspective is calling for conducting research in future to rectify these technical disturbing snags in modern surgery.

**Conclusion**

This review describes snapshots of modern surgical principles underlying diverse advanced tools and cauteries, new lights that have their origin in ancient traditional cautery, old window, and have wider clinical applications including diagnostic not only in surgical practice but also innumerable industries. Like traditional cauteries, modern electrosurgical units and procedures are associated with various adverse effects and complications, and this perspective is calling for conducting research in future to rectify these technical disturbing snags in modern surgery.

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