



## History of Cautery: The Impact of Ancient Cultures

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### Authors' contributions

*This work was carried out in collaboration between all authors. Authors SMS, AAHA and NAQ designed the study, performed the statistical analysis, and wrote the protocol. Author AAHA wrote the first draft of the manuscript. Authors SMS, IMAG and NAQ managed the analyses of the study. Author IMAG managed the literature searches. Author NAQ revised the paper a number of times. All authors read and approved the final manuscript.*

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### ABSTRACT

**Background:** Healers around the world successfully practice traditional cautery (in Arabic kaii) since ancient times. Traditional cautery, centuries of medical practice with unidentified exact origin has survived till today that authenticates its significance and effectiveness in mitigating human sufferings and diseases.

**Objective:** This overview aimed to describe and synthesise the literature on historical perspectives of traditional cautery.

**Methods:** The relevant literature published in English prior to 2018 was electronically searched in databases (PubMed, MEDLINE, Google Scholar, and OvidSP) using the Boolean operators and keywords. Manual searches and references of published articles and books were also conducted. A number of pertinent articles and abstracts (N=7490) were retained for extensive appraisal by two independent reviewers, and finally, 82 articles were included in this paper.

**Results:** The historical practice of traditional cautery is documented in diverse ancient cultures but the earliest references found in Surgical Papyrus (1550BC). The inconsistent data evidenced the origin of cautery, definitions, instruments, anatomical sites and techniques, advancements and research in traditional cautery since antiquity. Cautery was diminished in early 1800 century but

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revived in late 1800-1900 AD in the world. Presently, traditional cautery with better procedures and aseptic means is used by healers for treatment of a variety of diseases around the Eastern and Western world.

**Conclusion:** Traditional cautery has a checkered history and is a complementary modality for managing difficult-to-treat medical and surgical conditions. Scientifically more advanced modern types of cautery are used in the treatment of a variety of diseases across the world. This study calls for researching elucidating the underlying mechanisms of actions and effects of traditional cautery.

*Keywords: Traditional cautery; ancient cultures; history; cauterization; Kaiy.*

## 1. INTRODUCTION

Historically medicine with its ancient root is reported to be the noblest profession with a profound, sustained impact on human life and survival. Over centuries, a more significant medical knowledge based on innovative research is continuously built up that have benefitted humanity across the world [1]. This knowledge evolution and advancement is a never-ending mission. Cautery epitomised this historical developmental trend. Cautery– treatment by fire- is a traditional practice by healers and its use dates back to ancient times, shortly after the discovery of fire [2].Goldberg, an influential physician, emphasized on the healing power of herbs, songs, prayers and fire [3].Cautery is described as the application of corrosive materials (acidic and alkali), herbal drugs, hot metal or boiled oils or electric current, or fire to burn out parts of the skin or diseased tissues for a therapeutic purpose [2]. From the dawn of history, diverse ancient cultures across the world have venerated fire as a potent remedy and its multiple advantages. Some ancient cultures such as the Persian even worshipped it as their rituals. Simultaneously cautery was used to cure many diseases including warts, wounds, infections, bleeding, fatigue, stress disorders, gastrointestinal tract (GIT) diseases, fibromyalgia and musculoskeletal pains and other medical conditions including skin cancers [1,4,5]. Ancient Egyptians used cautery to stop bleeding. Hippocrates (Buqrat) recommended this traditional remedy in many medical conditions including haemorrhoid, abscess, dropsy, trachoma and sciatica [2,6]. Arab world used this religious therapy for centuries also for many health conditions [1].Overall based on basic principles of older times, centuries of practice by healers make cautery a praiseworthy therapy in the current holistic model of complementary and integrative medicine.

This overview aimed to critically analyse and synthesise the pertinent literature on a historical

perspective of traditional cautery. The significance of this study is that it will sustain the practice of cautery along with a focus on relevant research and training and bridge the knowledge gap of traditional healers and health professionals alike. Another important point is that it is the first overview of cautery (in Arabic Kaiy) from Saudi Arabia.

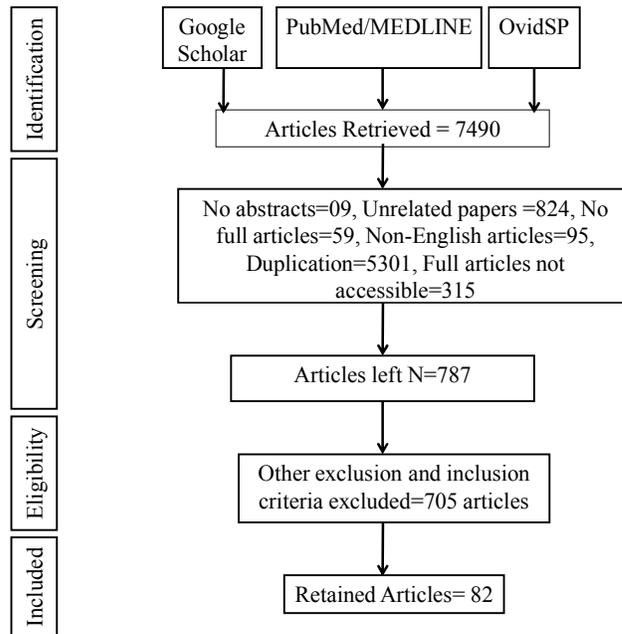
## 2 METHODS

### 2.1 Search Strategy

The relevant literature published in English prior to 2018 was searched in PubMed, MEDLINE, Google Scholar, and OvidSP databases. Furthermore, some publishing websites (<https://www.google.com/>, <https://www.jstor.com/>, <http://www.Science domain. org>, <https://www.researchgate.net/>and <https://www.hindawi.com/>) were also searched. The Boolean operators and keywords used in multiple electronic searches were “Cautery history AND traditional cautery OR cauterization OR Kaiy OR Amal-i-Kaiyy”, AND “cautery history AND Cautery techniques OR procedures”, “cautery history AND cautery tools OR instruments”, “cautery AND “definitions”, “cautery AND cautery forms”, “cautery AND ancient cultures”, “cautery AND different cautery methods”, “cautery AND cautery safety”, and “traditional cautery AND modern cautery”. The search strategy and the keywords were modified as appropriate according to the searched database. In addition, references included in full text articles, some books of traditional medicine concerning history of cautery were reviewed for inclusion.

### 2.2 Search Results

More than 7490 articles were retrieved and reviewed by two independent researchers (NAQ & SMS). Our focus was on full articles describing traditional cautery history. However, we also reviewed articles that gave brief descriptions of



**Fig. 1. The flowchart of selection of articles**

the history of traditional cautery. These brief sketches were reviewed critically and their important contents were incorporated in this review. The additional inclusion criteria were access to full articles, papers containing traditional cautery history information and all types of studies such as systematic reviews and meta-analysis, randomized clinical trials, observational studies, case series and single reports. After removal of duplications (n =5301), no cautery history at all (n =824), no abstract (n = 109), non-English articles (n =95), incomplete papers (n =59) and full articles not accessible (n =315), only787 papers were left for further review. Furthermore, 705 articles were excluded because of duplications of cautery history information (n=440) and containing irrelevant information (n=265). Finally, both reviewers agreed to include 82 published studies, including historical, traditional books on cautery in the present narrative overview. Now the total number of included studies is 82 (Fig. 1).

### 3. HISTORY OF TRADITIONAL CAUTERY

#### 3.1 Cautery, Definitions and Forms

In ancient times, hominins from all walks of life realized the value of fire; survival and becoming human through the processes mediated by fire.

The earliest evidence for hominin use of fire dates to more than a million years ago. However, the converging evidence from different archeological sites (Tabun cave) and recorded data suggest that the regular fire use established between 350,000–320,000 years ago [7]. In a short film "The discovery of fire", the director's statement echoed the complicated nature of fire which is a human story, a story about loss, a story about grief and ultimately a story about the complexities of acceptance and a story about love [8]. So fire is now considered to be a mixture of blessings and afflictions. Fire and cautery have an intangible relationship because when cautery was invented and who invented it is not known. One of the earlier references concerning to cauterisation is found in the books of Hippocrates (460-377BC) [9]. In his writings, Hippocrates advocated the use of traditional cautery in various disorders and comprehensively described it in his treatise *Kitāb-al-Fusūl* (Hippocratic Corpus) [10].

Traditional cautery is defined in different ways; a medical practice or technique of burning a diseased body part to remove it by using a red/white heated metal rod. Also cautery destroys affected tissue or injured vessels in order to stop bleeding as in cases of amputation and exsanguinous fluid. Cautery also eradicates

an undesired growth such as tumors and reduces infections. Chemical cautery uses corrosive drugs or materials or herbs-acidic or alkalis – whereas actual cautery refers to the metal device heated in flame and then applied to the damaged tissue [5,6,10]. Other form of cautery is one in which first the fluid from the affected site is sucked using cups (cupping therapy/Hijamah) to expose vesicle. Then bare vesicle is cauterized by fire but this technique is no more used [10]. Also cautery means the branding of a human, either recreational or forced [3]. Cautery (Kai) is one of the regimental therapies mentioned in the oldest Unani Medical System. It is a simple technique for the treatment of a disease and preservation of health [10,11]. In other words, Amal-i-Kaiyy (cautery) is the practice of burning flesh for multiple therapeutic reasons including stopping bleeding or other fluids, removing unwanted skin or creating an entry point into the skin using corrosive drug (caustic or acidic material) or red hot metal or fire or boiling oil or electric current over the affected locations [2].

### 3.2 Cautery and Ancient Culture Terms

Diverse cultures have used several terms for cautery since ancient times. In Old French, cautery or cauterization is called cauterizer. In Latin culture, cautery is called cauterizare or ferrum candens. Greek people called cautery kauteriazein or kauterion. In Persian and Unani medicine cauterization is known as Amal-i-Kaiyy or Kai or wasm [2,6]. In Arab Gulf nations, the practitioner is known as Mawasmer who applies wasm (cautery) to visiting patients [12]. In Arab States, traditional cautery is known in Arabic as Kaiy. Various terms that denote cautery are as follows: "to burn or brand with a hot iron", "burning or branding iron" and "I burn" [13]. In Tibb-i-Hindi, cautery is referred to as Agnikarma (thermal cautery) [2]. In Chinese culture cautery is conceptualized as moxibustion. In sum, cautery is termed by several different cultural names since antiquity and was used extensively for every possible purpose including as a 'counter-irritant', as a hemostatic, as a bloodless knife, and as a means of destroying tumors [14].

### 3.3 Cautery in Ancient Egypt

The culture is highly rich concerning ancient medical and surgical perspectives [15]. The use of fire cautery is traced in Surgical Papyrus written in 1550 BC [2,16-18]. The related text gave instructions for a swelling of vessels

possibly an aneurysm: "*Thou shalt perform an operation for it, knife heat with fire; it shall not bleed considerably*" [18]. In Edwin Smith Papyrus (1600 BC), a further description was given for tumors or ulcers in the breast, perhaps resulting from injury. "*One having tumors in head, breast, (and) they predispose to cysts of pus, ailments which I will treat with the fire-drill*" [19]. It is reported that ancient Egyptian surgeons used cautery for controlling severe bleeding concerning wounds [20]. There were possibly two different types of cauterizers and related instruments-fire-drill and hot lance- for cauterization used by antiquity Egyptian surgeons [21].

The pertinent literature further suggests that trepanation, i.e., cranial vault fenestration (in Peru) and cauterization, i.e., localized cranial vault burning (in French populations of Neolithic age) were used in prehistoric ancient cranial surgery as evidenced in the work of Broca (1867), Manouvrier (1895) and Moodie (1921) [22]. Nonetheless in prehistoric times, it was very difficult to differentiate trauma-related cranial effects from cranial disease or cranial surgical interventions [22]. Overall as the Arabic saying goes the use of cautery is recommended as the last or final treatment option in diseases not responsive to available treatment methods [1,23]. Hence, cautery now is not considered the first line of treatment by modern practitioners. However, still a variable number of patients first consult faith healers for cauterization in Muslim world and then conventional practitioners for their medical problems. This trend is vice-versa as well.

### 3.4 Cautery and Ancient Indian Medicine

Ancient Indian healers are known to contribute a lot to the traditional medical system. In Tibb-i-Hindi (Indian Medicine), Sushruta (600 BCE) is considered as the "founding father of plastic surgery" [24,25], and was listed as one of the ten sages residing in the Himalayas [26]. Sushruta authored the 'Compendium of Sushruta Samhita' and is considered the most famous surgeon for nasal reconstruction in Indian history of surgery [25]. Tau-dam or Agnikarma (Thermal cautery) mentioned in Ayurveda are terms used in Ancient Indian medicine for fire treatment. Agnikarma (Tau-dam) is basically a traditional alternative Himalayan therapy practiced by the rural Himalayan older people for a variety of medical ailments concerning liver, stomach, joints, spine, abdomen, sciatic nerve and back [25,27]. In

modern sciences, Agnikarma is epitomized cauterization or therapeutic burn. Agnikarma is compulsorily used in every child of 6 months to 1-year in India, especially in Hindu culture but this practice has diminished. According to Indian Medicine Sushruta, cauterization was also indicated for the veins and tendons related to various ailments [2,28] but this indication is abolished.

### 3.5 Cautery and Ancient Chinese Medicine

Cautery in terms of Moxa cautery (475-221 BC) in Traditional Chinese Medicine has been used in many diseases since ancient times. These diseases include but not limited to fatigue, fibromyalgia and pain syndromes, musculoskeletal injuries, arthritis, digestive disorders, and women's menstrual ailments. The Chinese moxibustion or Moxa cautery is the process whereby a dried processed herb of mugwort plant is burned either directly on the skin or just above the skin over specific acupuncture points (Stomach meridian point 36 or ST36) concerning a GIT medical condition [29]. Experimental studies in rats have provided greater insights into ST36 which is reported to have upregulation effect on GIT [30]. Zu San Li (ST36) is located four finger width down from the bottom of knee cap, along the outer boundary of shin bone, and associated with multiple benefits in several diseases of GIT and stress related disorders [29]. There are two methods of moxa cautery; direct with or without scarification and indirect. Moxa cautery with scarring is no more used in Chinese culture. In direct method, a cone of moxa is burned on the tip and its flat surface is placed on the skin till the pleasant smell is felt by the client. In indirect method, traditional Moxa is burned close to the skin to create a pleasant sweet sensation of warmth while tension drains away from muscles. It also invigorates and energizes the body and organs through using qi energy and further boost the immunity. Stagnation of contaminated blood and other fluids are expanded (versus contracted in disease) due to qi energy and stagnated blood begins to circulate smoothly. Indirect moxibustion-warming needle and moxa pole-is most commonly used in clinical practice. Moxa pole is like sticks that resemble cigars or incense rods. It is lit at one end until it is smoldering hot, and then it is held over an acupuncture point or region of the body to warm it (Fig. 2). In warming needle, an acupuncture needle is placed into a point on the body, and then a small ball of moxa is placed on the head of the needle. The moxa is

then lit, so that the entire ball of Moxa burns slowly and smolders completely. Here warming occurs not only the surface of the skin below the moxa but also the needle itself. In turn the qi deep within the acupuncture point [stomach 36 (ST36)] also gets warmed up and stagnated fluids begin to flow [29]. In his article on actual cautery Maunoir reported Pouteau's observations concerning instant application of the Moxa to the skin that resulted in the invigoration of the weakened parts of the body [5]. Thus, Traditional Chinese Medicine has offered the underlying mechanisms of Moxa cautery. Overall stagnated blood expanded through qi energy and circulates in the body which is the underlying mechanism of Moxa cautery. Ancient Chinese teachings advise that the formation of a blister is essential for healing to take place [29].



Fig. 2. Moxa cautery poles placed just above and on the affected skin

### 3.6 Cautery and Ancient Greco-Roman Culture (GRC)

The cautery is used in the treatment of various illnesses in Greco-Roman Medicine. Scribonius Largus (the first century Common Era author), pharmacologist and court physician (not a doctor) of Roman Emperor Claudius wrote a book on pharmacology "The Compositioes Medicamentorum" and advocated cautery therapy. Unlike Egyptian antiquity surgeons, the older Greek army surgeons were not experts in using cautery or ligatures in stopping bleeding [20]. Interestingly the electrical discharges produced by the torpedo fish attributed to occult powers in the medieval period were highly appreciated by Hippocrates, Scribonius Largus and Galen. The electrical discharges were prescribed for headache, gout and prolapsed anus. During renaissance period researchers studied the mechanical nature of the electrical provoked shock that paved the way for the discovery of the electrical nature of torpedo's activity. Consequently electrotherapy, a form of modern cautery was developed [31]. In an editorial, Papavramidou and colleagues reported that the physicians of ancient times used

remedies and plasters for local treatment of tumors but cauterization was used by the Hippocratic physicians for cancer of the pharynx [32]. Notably one of the earliest references to cauterization is found in the books of Hippocrates (460-377BC). In his writings, Hippocrates advocated the use of cauterization in various disorders and fully described cautery in his book *Kitāb-al-Fusūl* (Hippocratic Corpus) [9,33]. Accordingly cautery was used for the treatment of hemorrhoids by a white-hot iron rod until it becomes dried up [34]. Hippocrates also suggested the therapeutic use of cautery for abscesses, sciatica, plague and trachoma [29, 35]. Aulus Cornelius Celsus followed Hippocrates work and advised use of cautery (Amal-i-Kaiyy) in gangrene, fistulas, improperly grown eyelashes, drooping eyes (ptosis), severe hemorrhage, discharge from eyes, and blood and pus exuding ulcers and introduced a cauterizing knife in abscess treatment [2,6,36]. Archigenes of Apamea, a Roman medical author and practitioner advised use of cauterization to stop bleeding during surgical operation of cancerous growth [32]. The second most eminent physician Galen (Jālinūs) (131–199 AD) wrote a treatise "*On tumors against nature*" and recommended the use of cautery for burning the roots of a tumor/cancer (breast cancer), which might be associated with potentially dangerous bleeding [37]. However this ancient procedure resembles modern day technique of thermoablation [38]. Leonides of Alexandria disregarded all restrictions against operating cancer (of breast) and described a detailed procedure in which excision is alternated with cautery, the latter assisted to remove the cancer and stop bleeding [39]. Papavramidou and colleagues observed that both Archigenes and Galen suggested using cauterization rather than ligation in order to increase patient survival because like cautery thermal energy has the additional ability to kill cancer cells but ligation only control hemorrhage [32]. Like Hippocrates, other famous physicians Albucasis (westernized Al-Zahrawi), Marcus Aurelius Severinus and Ambrose Pare have spoken of fire as a truly useful means in surgery [5]. Overall ancient Greco-Romans legitimately contributed to the development of cautery and its uses in medical diseases.

### 3.7 Cautery and Ancient North American

The archaeological evidence of ancient cranial surgery is mainly related to trepanation (cranial vault fenestration) and cauterization [22]. Archeological excavations have revealed that

cauterization was also employed as a treatment modality in North America in ancient ages, as is evident from a cauterized skull found in California, which was estimated to be of around 300–500 AD [22]. Cautery is depicted as a form of surgery, i.e., a localized cranial vault burning and was also described in French populations of Neolithic age [22].

### 3.8 Cautery and Unani Medicine

Cautery in Unani Persian medicine is an important component of regimental therapy (Ilaj Bit Tadabir) [2,10]. Unani physicians used cautery for a variety of therapeutic purposes including removing unwanted skin [40]. Aflatūn Saghīr (Saqbali) wrote a book about cauterization [33]. Rufas, the renowned Unani physician, discussed the use of cautery (kaiy) for the treatment of mad dog bite. Hakim Salsus advised it for entropion which is a genetic medical condition in which usually the lower eyelid folds inward and the eyelashes continuously rub against the cornea causing irritation and trichiasis (eyelids remain at normal position, and eyelashes rub against the eyeball) and inguinal hernia. Notably the inguinal hernia should be cauterized after retraction of the intestine [2,33]. Hakeem Jalinoos (131-201 AD) recommended Amal-i-Kaiy(cautery) in the management of warts [33].

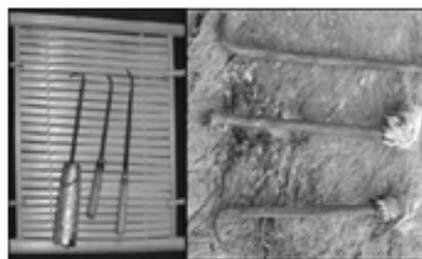


Fig. 3. Primitive and modern cautery tools

### 3.9 Cautery in Pre-Islamic Arab Culture

Cautery before Islam was favored and at the same time not prohibited. Cautery (Kaiy in Arabic) is one of the most ancient forms of therapy used by the traditional Arab healers over centuries. This is because ancient Arabs had great faith in the therapeutic value of sacred fire [1]. Cautery was used more frequently among Arabs compared to Greeks. Cauterization was effected more commonly using caustic soda (potential cautery) to destroy tissue than actual

cautery by fire-heated metallic sticks [41]. For holding purpose, primitive cautery tools used to be rapped with cloth for heat insulation at its one end while the modern cautery tools equipped with wood handles (Fig. 3). Arab physicians popularized treatment by cautery before Islam and signified Kaiy as one of the treatment options in medical and surgical conditions [2]. The famous Arab physician (Hunain Ibne Ishāq) wrote a book on cautery named "Ikhtiyār-ul-Adviā Al Muharriqā" (translated as Selection of Burning Therapies/drugs). This book contains details of medicinal drugs beneficial for various diseases when used as cauterizing agents [2,33]. Medical herbs, cautery (kaiy) and Al-Hijamah (cupping therapy) were the major therapeutic modalities of ancient Arab Traditional Medicine [1,42]. Interestingly the Arab cautery (Kaiy) is conceptually similar to the Chinese older therapy of moxibustion which is defined in above-mentioned section concerning Chinese culture [1]. Conversely the Arabic cautery (Kaiy) uses heated white metal sticks or iron nails on diseased site since antiquity (Fig. 4).

In African Somalian context concerning cautery, Somali traditional healers and physicians imported medical systems from Arabs, Indians and Persians and adapted their own health system along with a mix of pre- and post-Islamic concepts. Religious and spiritual beliefs such as spirit, evil eye, envy, jinn and disrespecting ancestors guided Somalis to mostly seek help from traditional practitioners (Sancoole). African continent people share such religious beliefs and custom. Cautery was the main therapy for alleviating various diseases such as hepatitis, facial paralysis, parotitis, and childhood rickets (rickets). Almost all Somalis are reported to be cauterized in their lifetime with wood, or palm leave or iron rode [43]. Concerning Sudan, ancient Arabs and Egyptians influenced its culture and Islamized the country. Many surgical procedures are carried out by the skilled persons (basir). Cautery was used to treat chronic illnesses, headache and jaundice with specific cautery positions/locations for different illnesses [44].

### 3.10 Cautery in Post-Islamic Muslim (PIM) Culture

Islam discouraged but never prohibited the use of cautery around the world. With the dawn of divine Islam, Islamic traditional therapies began to take hold of prevailing traditional therapies and transformed them for safe uses. The traditions

(Sunnah) of Prophet Mohammad (PBUH) specifically helped thriving health and medical supervision including of traditional cautery. Islamic reliable sources state that Prophet said: *"Healing is in three things: a gulp of bee honey, Hijamah (cupping therapy) and Kaiy (cauterization) but I forbid my followers to use kaiy"* [45]. This Hadith of Prophet Mohammad is also recorded in another way; *"If there is any good in your medicines, then it is in a gulp of honey, Hijamah (cupping operation), or branding with fire (kaiy) that pains but I do not like to be branded"* [45]. On one occasion, the Prophet of Islam (Mohammad) cauterized Sa'd bin Mu'adh (injured in the battle of trench), one of the prominent companions of the Prophet on his medial arm vein to stop bleeding [46]. Furthermore, Anas was also cauterized by Prophet himself when he had sepsis on his finger [47]. Evidently the Prophet was not in favor of this procedure as a routine (probably in contraindicated cases) but he allowed its use only in severe resistant medical cases (possibly indicated cases) [47]. The two probable reasons may be given: one reason was his awareness of the Arab's strong trust in cautery as curative and he wanted Muslims to keep their faith in almighty Allah as the ultimate healer, and not cautery. The second reason was that it is only almighty Allah who will punish sinner persons by fire in the hereafter, so he did not want people to be subjected to its pains herein life on the earth [1]. In many Arabic villages about 30 years ago or earlier, quacks such as barbers used to perform circumcision, Al-Hijamah and Kaiy [48]. However, currently the landscape has changed and circumcision on males (on females is controversial) is done with aseptic technique [49,50]. Notably Kaiy is still performed for the treatment of many health conditions by religious faith healers and qualified health professionals in all age groups [23,51] including children with GIT problems, respiratory, neurological including polio, chronic infectious, hematological and renal disorders with variable outcomes [52-54]. In a systematic review concerning recurrent nose bleeding in children, silver nitrate cautery was found effective in recurrent nosebleeds, from 13% to 54% of patients and 25 % failed to respond [55]. Judd developed a novel technique (combined cupping suction, cauterization and sheath/cover) to cauterize successfully epistaxis of posterior nose [56]. Overall in present scenario traditional cautery and cautery with developmental advancements are used in a variety of diseases with varying effectiveness.



**Fig. 4. Traditional cautery - red/white-heated metal sticks**

### 3.11 Cautery and Ancient Arabic Surgery

Cautery as a profession was central to ancient Arabic surgery. The Prophet of Islam gave approval to Kaiy to be used in medical conditions, though he did not favor its use in routine clinical practice. This Prophet's insinuation inspired Arab and Muslim physicians across the world to further the cause and science of Kaiy. Consequently significant academic and clinical researches concerning cauterization were performed and published during the middle ages. The related documented research data contributed greatly to the knowledge of people that helped preserve the essential perspective of cautery (Kaiy) for future reference and its use in medical conditions [6]. Among the earliest Muslim physicians to conduct research on Kaiy was RabbanTabri (810-895AD) who mentioned the use of Kaiy in the treatment of sciatica in his famous encyclopedic treatise "Firdaus al-Hikmah" (The Paradise of Wisdom) [57]. Later, his famous pupil Mohammad bin Zakariya Razi (850-923 AD) who wrote a book "Kitab Al Hawi-fil-Tibb" described the use of cauterization (Kaiy) in sciatica, piles, coxalgia, and hemorrhage [37,58,59]. Another famous Persian physician-scientist was Abul Hasan Ahmad Bin Mohammad of 10century (985AD) who wrote a book "Kitabal-mu'alajaal buqratiya" (Hippocratic Treatments) and propagated cautery and described its use in various disorders [60]. Ibn Rushd advocated medical cauterization and mentioned some drugs that "act like fire" [61]. According to Karenberg and Hort, the use of the cautery in "chronic apoplexy" was a special feature of Arabic surgery [62]. According to Hajar Al-Binali, cautery remains one of the major traditional therapies of Gulf Arab world [1] because it is clinically effective in many medical and surgical conditions [1,5]. In nut shell, traditional cautery is of high historical importance because it concerns pre- and post-Islamic and prophetic medicine, other diverse cultures and a precursor of modern cautery in medical sciences.

### 3.12 Ibn Sina and Kaiy

Abu-Ali al-Husayn ibn-Sina was the greatest of the Arab Muslim scientists of the medieval period. Ibn Sina (in Latin Avicenna, c.980-1037) recommended the use of cautery in his surgical encyclopedic textbook "Kitab al-Qanon" (The Canon of Medicine) [63], a well-known book in medical history academia. In the words of Ibn Sina cautery is a very useful method of treatment, prevents the spread of destructive lesion, has an invigorating effect on cold temperament, and breaks up putrefactive matters imprisoned in a tissue. Cautery restrains the flow of blood and arrests hemorrhage. For all these, great heat is required with vigorous cauterization so that a firm thick scar is produced which will not readily come off. Accordingly cautery helped in controlling the spread of infections and sepsis from diseased to healthy organ such as in catarrh (excessive discharge or build-up of mucus in the nose or throat linked with inflammation of the mucous membrane). Cautery dries up sinuses and wounds because cauterization burns the contaminated noxious humors [63,64,65]. Ibn Sina was found of writing medical poems, which consists of precisely classified 1326 verses in "The Canon of Medicine" [66]. Ibne Sina wrote a poem about cautery; "*Stop a bleeding artery.....In the body with cautery....Stop a bleeding artery.*" Ibn Sina suggested that cautery rode made of gold is the best device but Al Zahrawi had differed because of unwanted qualities of gold like melting and running from the wound when heated [63].

### 3.13 Al-Zahrawi and Kaiy

Al-Zahrawi, an Arab Andalusian Muslim physician, surgeon and inventor is known by the name of Abul Qasim Al Zahrawi (westernized as Albucasis, 936-1013 AD). Zahrawi (Latinized as Abulcasis) name is derived from a beautiful city Al-Zahra built by Abd Al-Rahman III near Cordoba (Spain) in 936 AD. Al-Zahrawi of Islamic Golden Age and the father of surgery compiled a renowned surgical book entitled 'Kitab Al-Tasrif'. This book is a manual of the medical art representing all branches of medical sciences [67]. This surgical textbook influenced medical profession around the world for five centuries. Al-Zahrawi recommended cautery as a form of treatment and developed and described techniques and special instruments called cauters to stop bleeding from wounds or injured arteries [67,68]. Other methods to controlling an arterial hemorrhage were division of the vessel,

ligatures, or styptics applied on a compress tightly bound over the wound [20]. Indeed Al-Zahrawi developed clear and complete guidelines concerning procedures, instruments, techniques, precise sites of cauterization and highlighted its indications, precautionary measures, and related possible risks [6]. He recommended cauterization with hot metals or hot oils to stop vascular bleeding along with treatment of many diseases like epilepsy, otalgia, headache, facial palsy, toothache, oral fistula, backache, eye diseases, depression (melancholia) and hemorrhoids [6]. In his treatise, Al-Zahrawi also presented impeccable illustrated diagrams of various forms of cauteries used in various organ diseases. This is the first book that contained highly meticulous and thorough diagrams of more than 50 cauteries [69]. Later a Muslim Turkish physician, Şerefeddin Sabuncuoğlu (1385-1468) arranged the art of cauterization in his masterpiece entitled "Cerrahiyetül Haniye" (Imperial Surgery). This treatise greatly contributed to the practice of cauterization with highlights of the illustrated diagrams of Kaiy techniques in a variety of diseases [70]. Overall Zahrawi and his contemporaries developed related paraphernalia of cautery in terms of guidelines, techniques, illustrative diagrams, application sites and other clinical perspectives.

### 3.14 Traditional Cautery and European Culture

Later the practice of Kaiy spread to the practitioners of European nations who used cauterization primarily as a method of performing amputation with little loss of blood. Cauterization was widely practiced as a method of controlling bleeding in injured persons and also to reduce the toxic effect of gunpowder (from gun battle) in wounds from gunshots. At the same time cautery remained a practice popular with the Arabs. Cautery became the standard treatment for wounds as well as to control bleeding in European surgery in the Middle Ages [20]. This was because physical contact with the sick was undesirable to physicians in the Middle Ages, and cautery substituted sutures and ligatures. Ambroise Paré (c.1510-1590), the most notable French physician and surgeon, often referred to as the founding father of modern surgery practice, who pioneered the use of less irritating emollient made of egg yolk, rose oil and turpentine for substituting the cauterizing gunshot wounds by boiling oil, an extremely

dangerous and painful procedure [71]. In addition, Paré described more efficient techniques for the effective ligation of the blood vessels during an amputation surgery [71].

### 3.15 Historical Revival of Cautery

Despite continuing advancements in cautery, traditional cautery never abolished from the world. Moreover the cauterization practice was fully revived in the late 19th century AD and retained its clinical value in modern medicine. A well-known surgeon of late 18-19 century (Maunoir JP) has described the successful use of cauterization in various disease conditions like non-healing sinuses, local scrofula (a disease with glandular swellings, probably a form of tuberculosis of lymph nodes of the neck), fistulas, sinuous, ulcer (of lip), bite (8-10 wounds) of a mad dog, rheumatism, benign tumors, fungal infections and tumors, oral and teeth problems, rheumatism, and polyps [5]. As a result of cauterization, patients hardly complained of pain during the procedure and instant benefits strengthened their regular followup session with the therapist [5]. Maunoir has beautifully detailed the up and down of cautery/fire use of the past two thousand years and its subsequent revival in Europe. Although cautery has advanced from hot-metal to the more sophisticated electrocautery, laser cautery and galvanocautery in the recent years, however, there are still many advocates for practicing cautery in an approach similar to that described by the ancient traditional healers, physicians and surgeons. The cautery instrument used nowadays is usually a metal rod that is pointed at one end or bent at the top into a crescent shape [12,72]. Until now traditional cautery survived and remained an important therapeutic tool in many parts of the world, especially in the Eastern landscape [23,52-54] because of many reasons including Islamic religious beliefs, societal custom, parental guidance, chronic resistant psychophysical disorders and failure of modern interventions, illiteracy, rural background, cost and effectiveness [1,6,12,23,45-47,52-54]. Many researchers of modern times tend to question the effectiveness of traditional cautery attributed to the chronic and resistant nature of the illness, complications, severe pain, infections, and biases including unknown mechanisms [48, 52,53]. Overall cautery is a practice of centuries by healers but with little research support and certainly a complementary therapy for persons requiring holistic healthcare.

### 3.16 Historical Uses of Cautery

Traditional cautery had been used in wide variety of diseases using its different shapes and anatomical site [12]. In Egyptian culture cautery was used in aneurysm, breast tumor, ulcers, and cysts [2,16-19,21]. In Indian system of Medicine, Agnikarma (thermal cautery) was used in diseases of liver, GIT, joints, spine, sciatic nerve, back and veins and tendons [2,25,28]. In Chinese culture, moxibustion (cautery) was used in fatigue, fibromyalgia and pain syndromes, musculoskeletal injuries, arthritis, digestive disorders, and women's menstrual disorders [29,30]. Greco-Roman physicians used cautery in headache, gout, prolapsed anus, hemorrhoids, abscesses, sciatica, plague, trachoma, gangrene, fistulas, ingrown eyelashes, ptosis, eye infections, and ulcers [2,9,16,17,20,29]. Unani physician used cautery to stop bleeding, mad dog bite, entropion, trichiasis, inguinal hernia and warts [2,33,40]. Al Zahrawi recommended cautery in the treatment of epilepsy, headache, toothache, backache, depression and hemorrhoids [6,67-69]. Al-Zahrawi reported to inform his son that cautery does not work in every disease and symptoms of diseases treated by cautery may reemerge [1]. As mentioned up Maunoir's work in revival of cautery could not be underestimated who used cautery effectively in multiple chronic diseases not responding to any available treatment during his epoch [5]. Prior to and after Islam, traditional faith healers including quacks and barbers used cautery in various diseases including jaundice and apoplexy [2,6,12,33,57-63,67-70,73,74]. Cautery induced pain and spread of infections and in some cases failure along with lack of research concerning its underlying mechanisms remained the main barriers against its restricted use since centuries. Conversely ancient physicians and healers propounded that cautery reduces the pain, treats infection and founded on fundamental principles of traditional system [5]. In sum, ancient diverse cultures of the world have been successfully using traditional cautery in multiple diseases.

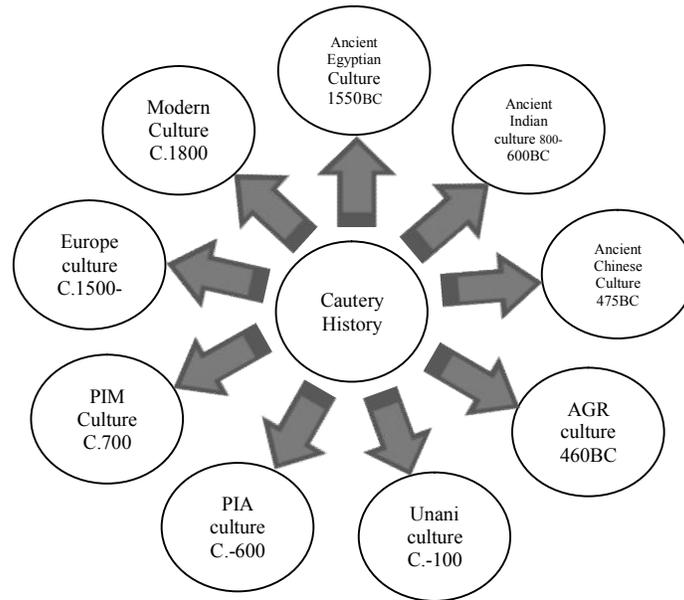
### 3.17 Cautery Technique, Sessions and Sites of Application

The traditional cautery utilizes metal sticks or iron nails in Muslim world. The sticks are heated over hot charcoal until they become as red as the hot charcoal. Then, the practitioner places the hot metal over a specified location over the skin for a

few seconds. The number of cautery in one session varies between one to seven or more sittings. Skin-deep burn followed by gross scar is the expected result. The choice of the location for the application of the cautery depends on the patient's complaints and disease types [12]. For example jaundice, the cautery is applied to the left hand. If the patient complains of chest pain with shortness of breath, (which could be angina or myocardial infarction), it is applied to the 4th and 5th anterior or posterior ribs on the same side of the pain. The patient is usually instructed to avoid wetting the burn area for a few days after the procedure as well as avoid the use of perfumes or eat food that produces gas. For sciatica, it could be from one to 17 cautery burns at different locations. In a qualitative study, Gazanfar specified more details of cautery types, techniques, indications, specific sites of application on the body corresponding to the specific diseases [12]. The Gulf Arabs rarely use cloth or palm leaves [75] or boiling oil instead of heated metal for cauterization. The boiled oil was mainly used to cauterize bleeding from cut limbs (amputations), especially right side. Cutting limb was a legal punishment for thieves especially in Arabian Peninsula. Now it is nearly extinct. Unlike ancient practitioners who suggested spring is the best time for cautery application, Al-Zahrawi differed and recommended that cautery could be used at all times [1,63]. Furthermore Al-Zahrawi criticized earliest physicians' belief that once a patient treated with cautery never relapse or complain of old or new symptoms. Hence, cautery is associated with permanent cure only in some diseases. Al-Zahrawi developed special cautery instruments for individual eye diseases, acute (non-chronic) migraine and lung diseases [1,63]. The ancient healers from all cultures and societies were short of fully explaining how the traditional cautery works and bring about clinical improvement in medical illnesses, though humoral theory, stagnation and qi energy, and religious beliefs were pervasive since antiquity.

### 3.18 Traditional Cautery and Modern Cautery

Traditional cautery has a checkered history. The use of cautery diminished from routine practice around 1800 AD in some parts of the world; however its use continued in various diseases by traditional healers in some ancient cultures including Muslim culture. The chief reasons for cautery's elimination especially from England were the abuse made of fire in the treatment of local gout and the anathema fulminated against it



**Fig. 5. Traditional cautery and ancient to modern civilizations (AGR=ancient Greco-Roman, PIA=Pre-Islamic Arab, PIM=Post-Islamic Muslim)**

by a celebrated British. Mr. Sharp managed to abolish actual cautery in which chemical-caustic or acidic- is used. Similarly Dionis condemned actual cautery in Paris. Mr. Cooper who wrote 'Surgical Dictionary' followed Mr. Sharp in devaluing fire and cautery, even did not mention its use in an article concerning mad dog bite [5]. However, Percy's "Pyrotechnia Chirurgicale" is a classical work and useful and indispensable concerning sacred fire and cautery and reported to a desired thing in English surgery [5]. Maunoir wrote extensively about fire and cautery, its clinical applications, techniques and procedures, effectiveness in difficult to treatment cases, and ultimately helped in revival of this traditional practice [5]. However the advent of ligatures and tourniquets to control bleeding and the use of antiseptic measures in infected wounds helped decline clinical applications of cautery. Modern cautery developed with the invention of electrical diathermy. This form of cautery produces heat in a controlled better way [76]. This technique became a very common practice to date for stopping bleeding during surgery. Currently many forms of cautery and cautery devices are used in medical sciences; electrocautery (or thermal cautery-unipolar and bipolar), chemical cautery (silver nitrate, trichloroacetic acid and cantharidin), and electrosurgery including electrocoagulation, electrofulguration, electro-

desiccation and electrosection are used in various diseases including skin ailments [77].

#### 4. DISCUSSION

This overview described the history of traditional cautery which is successfully practiced by healers since ancient times. The origin of traditional cautery is debatable and indeterminate; however, it is firstly mentioned in Surgical Papyrus written in 1550BC by ancient Egyptians [16-18]. In a related development, regular use of fire is reported to be between 135,000-132,500 years ago [7]. One would conjure up why traditional cautery was not invented before or after such a long period. Multiple explications might be put forward including healers might be practicing traditional cautery in diseases since prehistoric times (c.3.3 million years ago) but were not able to document it in any languages because of late invention of writing systems (c.5300 years ago). Overall cautery practice without its documentation in any form by uneducated healers persisted for centuries even after development of writing systems. This knowledge gap of thousands of years concerning ancient healers and cautery needs to be bridged possibly using advanced archeological means. Some progress had been made in the past [7,22] but more research is

needed further to bridge the gaps related to pre- and post-historic cautery.

Other important historical sources of traditional cautery are found in Indian culture (600BC) [24-28], Traditional Chinese Medicine (475-221BC) [5,29,30], Hippocrates and contemporary physician and surgeon writings (460-377BC) [2,5,6,9,29,32-39], pre- and post-Islamic books (c600-700) [6,20,45, 57-60, 63-69], Unani medicine (c.700-900) [2,10,33,40], European medical documents (c.1500) [20,71] and possibly North American culture (c.300-500) [22]. Unani physicians especially Aflatun Saghir who wrote a book "Amal-i-Kaiyy" used cautery after invention of fire as evidenced in Hippocrates book (Hippocrates corpus) [2,33]. Celestial earth astonishingly remained in its orbit/place but people continuously migrated across national and international boundaries carrying with them their ancient cultural practices including traditional cautery. From other perspective, cautery may have its origin just after fire invention but until now it was never abolished completely from the world [1,2,5,6,10,12,23,33] despite some attempts made by Mr. Sharp and his contemporaries against corrosive cautery [5]. Overall traditional cautery has rich history embedded with inconsistencies and diverse ancient civilizations including Egyptian [16-21], Indian[25-28], Chinese[1,5,29], Greco-Roman[5,9,20,31-39], Unani [2,10,33,40], Islamic [1,2,33,41,42], and European [20] have contributed to the invention and dissemination of traditional cautery along with its paraphernalia around the world. Furthermore, Chinese researchers elucidated the underlying mechanisms of action concerning ancient practice of moxibustion (the thermal effects, radiation effects, heat sensitive receptors, and pharmacological actions of moxa and its combustion products, heat-sensitive acupoints)[78,79], and traditional cautery shares some of these effects especially thermal and radiation effects and both need further basic research. Furthermore we speculate that acting on meridian points, moxibustion may stimulate a number of receptors in the brain releasing various neurotransmitters that reduce the pain sensitivity and increase tolerance to pain. Further research is needed for elucidating other mechanisms of traditional remedies including cautery and moxibustion in future.

With special reference to traditional cautery and Islam, Prophet Mohammad (PBUH) recommended cautery as the last option for the

treatment of a variety of resistant conditions and discouraged its regular use but never proscribed its practice [45-47]. Both Muslim healers and followers of Islam and Prophet's Hadiths including about traditional cautery tend to sustain and support the unique identity of cautery in Islamic world [1,2,6,33,12,33,41,42,53] since older times. Nonetheless, some studies based on two case reports have called for banning traditional cautery [48] which is rather offensive and disagreeable. Simply speaking banning traditional cautery is against the guidance of Prophet Mohammad which will not be acceptable to traditional healers and probably Muslims at large. Notably modern cautery with its several types has its root in traditional cautery which will continue to survive across the world as patients including children tend to benefit from it [12, 21,51-54].

The history evidenced that traditional cautery is safe and effective in many diseases [2,5,6,10-12,27,28,53,67]. Since ancient times, several studies have progressively identified types, indications and contraindications, precautions, techniques and procedures (including cleaning and disinfecting cautery instruments), and anatomical locations of traditional cautery and mechanisms of action and effects [2,5,6,10-12,25-28,32,33,48,53,67,74]. The detailed guidelines to clean and disinfect thermal cautery and surgical instruments are available here [80] that could be applied to traditional cautery. Overall more than thousand centuries of traditional cautery practice further evidenced its variable effectiveness in a variety of diseases supported by many studies [81,82]. In mathematical models, Tanaka and colleagues explained that the most efficacious treatments are not necessarily those most likely to spread compared with superstitious remedies and practices, which lead to a larger number of converts compensating for greater rate of their rejection [83]

No medical intervention is without adverse effects. Traditional cautery is associated with several adverse effects which are spread of infections, severe pain and bleeding, deep burn, tetanus, infected blister, delayed wound healing, spread of cancerous cells, keloid, burn scabs, multiple scars and disfigurement [10,23,63, 84,85,86]. Concerning infection a debatable issue, cautery is reported to be used successfully in various diseases including infection and conditions associated with severe pain [1,4,5, 87]. In a case series study (n=10), two patients

developed tetanus following cautery [84]. In another case report (n=4), skin branding with hot metal rod (types - strike branding, hypothermal (freeze) branding, chemical branding, electrocautery branding and laser branding), a common practice in western world that uses "counter irritation" as working mechanism is reported to cause severe infectious complications such as septic shock (two patients), cavernous sinus thrombosis (one patient) and multiple splenic abscesses (one patient) in four patients having chronic potentially serious diseases; two died, one developed permanent unilateral blindness and one fully recovered [72]. These are very rare complications of traditional cautery when used in potentially serious medical conditions (hepatitis C, exacerbated open angle glaucoma, chronic diabetes, chronic malaria with enlarged spleen, metastatic melanoma, cervical bleeding with cancer, etc). Notably the larger contribution by these diseases to those complications cannot be excluded. Other complications associated with skin branding done 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, infections and transmission of hepatitis and HIV [87-95].

Many of these adverse effects and complications are preventable as well as manageable. After effects of cautery especially scabs could be treated by using topical medications made from natural products such as wheat, olive oil, and water [59], and radish, celery, honey, pure butter (desi ghee in Urdu or samna baladi in Arabic) and vinegar [10]. In addition, rare complications of cautery or branding based on some case reports and small sample size study could be reduced by qualified professional cauterists using specific aseptic procedure and antibiotics, properly applying cautery at a specific place linked to an indicated specific disease[2,12,72,80]. Patients with advanced complicated diseases should never go through traditional cautery. Overall traditional cautery needs not to be blamed for adverse effects and complications rather traditional healers with no formal training and medical education and untrained professionals are accountable for causing such adversities among patients with potentially dangerous and advanced diseases.

Their integration into mainstream complementary and integrative healthcare system and intensive training in traditional medicine including cautery and branding is call of the time.

This overview has some limitations. This is not comprehensive and systematic. Furthermore study of ancient texts dealing with history of traditional cautery provides the researchers with numerous conflicting conclusions that can be neither verified nor falsified. Translation of ancient texts from one language to another may also distort the factual writings. Another limitation is that it is very difficult rather impossible to have access to every ancient books and published articles, the latter being high priced items. Ancient books are often quoted from collateral sources. In this process some ancient information about traditional cautery may or may not reflect its true perceptions. Therefore both the publication and selection biases are other caveats. The strength of this pilot overview is that it supports the judicious use of traditional cautery in the world. This overview does encourage the use of cautery in patients with indicated diseases and discourages in contraindicated complicated ailments. In the same vein, the unique identity of traditional cautery needs to be maintained throughout the world.

## 5. CONCUSSION

Cautery is an ancient traditional therapy practised healers across the globe since ancient times. Traditional cautery has checkered history, but most practitioners from diverse cultures of the world successfully practised it in the mitigation of human sufferings and diseases. Despite technological advancements in cauterisation techniques in modern medical sciences, traditional ancient cautery is survived due to a variety of strong socio-cultural beliefs. This historical overview calls for future studies to provide evidence-based data concerning the sociocultural factors, clinical perspectives and basic underlying mechanisms of action and effects of traditional cautery in different diseases.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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