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Historical use of silver nitrate for the management of epistaxis – evidence-based practice?

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Review Article

Mr H Tailor takes responsibility for the integrity of the content of the paper

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Abstract

Objective. Epistaxis is one of the most common emergencies presenting to the ENT service, and silver nitrate cautery is the mainstay of epistaxis treatment in most centres worldwide. This review aimed to ascertain the historical evidence behind current common practice.
Method. A review was conducted of historical published literature pertaining to epistaxis management.
Results. Silver in medicine dates back to 4000 BC, with silver nitrate first being used in 69 BC. Modern medical use for epistaxis is documented in case reports over the last 200 years.
Conclusion. The precise origin and evidence-based practice of using silver nitrate for epistaxis is not well-established or understood. The mechanism of action is questionable; novel research of silver nitrate for this common ENT emergency presentation may be required.

Introduction

Epistaxis is one of the commonest acute presentations to ENT. The anterior septum in particular is a highly vascular plexus, as it is supplied by branches of the facial, maxillary and ethmoidal arteries. Therefore, as well as environmental causes of bleeding, secondary epistaxis can also be a common presentation of systemic conditions. It is estimated that approximately 60 per cent of people experience epistaxis in their lifetime.[1] There appears to be a peak in adolescence followed by a further peak in older adults, representing a bimodal distribution of incidence.[2]

Between June 2018 and June 2021 in the West of Scotland, epistaxis was the cause of the highest number of adult hospital admissions (15.6 per cent) and bed days (10.5 per cent) under ENT according to Public Health Scotland data (www.publichealthscotland.scot). However, this does not include all those patients treated and discharged from emergency departments. Therefore, the burden of the population presenting is likely to be much higher. These data suggest epistaxis places a significant burden on the ENT service, and its management should be well understood in order to achieve optimal outcomes.

In 2017, Integrate, the National ENT Trainee Research Network, published their consensus recommendations on epistaxis management.[3] After an initial structured airway, breathing and circulation ('ABC') approach to assessment, traditional first aid techniques should be applied to try and halt the bleeding.[3] The consensus is that nasal cautery should be used as the first-line treatment, but this requires targeting of the bleeding source.[3] Non-dissolvable anterior nasal packs should also be considered in some circumstances; for example, when cauterisation is ineffective or inappropriate, or when bleeding persists after first aid treatment.[3] If conservative management fails, surgery such as targeted diathermy and/or arterial ligation should be considered over interventional radiology for vascular embolisation.[3]

Based on the Integrate consensus, the first-line treatment is silver nitrate cautery. However, the evidence for its use is poor and low quality; nevertheless, it received high consensus agreement from the committee. As epistaxis is such a common ENT presentation and given the increasing drive for evidence-based practice, it is questionable how silver nitrate became commonplace in the management of epistaxis. This article explores the historical evidence behind the modern practice that is seemingly underpinned by little evidence.

Materials and methods

We performed a literature search using the PubMed database and Google Scholar web search engine. The following key words were used when screening for relevant articles: epistaxis, silver nitrate, chemical cautery, nosebleed, cauterisation and electrocautery. Relevant texts were organised into chronological order. Any texts not written in English language were translated into English.

Results and discussion

What is silver nitrate?

Silver nitrate is an inorganic compound; its formula is $AgNO_3$. It is a caustic compound that can be produced by dissolving silver into nitric acid. Its appearance is a white crystalline solid. It is soluble in water and corrosive if ingested.[4]

Silver nitrate was discovered in the thirteenth century by Albertus Magnus in Germany, known as Doctor Universalis, one of the forward thinkers of the Middle Ages, who had interests in both science and theology.[5] The product was named Lunar Caustic, because of silver's association with the moon at the time.[6]

Since as early as 4000 BC, the properties of silver have been understood. Yet, this was in a much less complex form than today. The King of Persia, Herodotus, said that 'no King of Persia would carry water in anything but a silver jar'; it was thought that this would purify the water, perhaps because of its anti-bacterial and disinfectant properties.[6]

Although the creation of silver nitrate was not documented until the thirteenth century, it may have been used as early as 69 BC. An early pharmacopeia published from this time mentions its use.[7] The first official use of silver nitrate in medicine for wound healing was reported by Gabor in 702–705 AD.[8]

In 1520, Paracelsus used silver nitrate as a caustic in wound treatment, an intervention that has continued to the modern day.[9] The next documented use of silver nitrate came in 1614, when the Italian physician Angelo Sala used it as a treatment for skin irritation, whilst also using it as a laxative and in the treatment of brain infection.[9] The Indian Army Officer James Abbott, in 1827, noted how he used silver nitrate in the wound of his arm after being bitten by a dog, in order to cauterise the wound and prevent rabies infection.[10]

The next involvement of silver nitrate in the development of medicine occurred in the 1880s. A German obstetrician named Credé used a 1 per cent silver nitrate solution as a prophylactic measure for gonorrhoeal ophthalmia in children.[11] Following this, silver nitrate prophylaxis became mandatory across most of Europe and Northern America until the development of antibiotics.[11]

Silver nitrate for epistaxis

Silver nitrate used for the cauterisation of bleeding was described as early as 1842, when Miller described various topical chemical pro-coagulants, but favoured silver nitrate for use in dental procedures.[12]

The earliest evidence of silver nitrate being used in the nose was from Philadelphia in 1854.[13] Management included 'local application of injection of astringents, as a strong solution of the nitrate of silver applied by means of a camel's hairbrush'. The use of silver nitrate on this occasion, however, was to treat chronic inflammation of the mucous membranes of the nose. Treatment of epistaxis at this time included similar first aid advice to today, alongside 'plugging' of the nose.[13] In 1894, Fullerton[14] published perhaps the most comprehensive account of epistaxis management experience, which is remarkably similar to the modern management techniques suggested by Integrate (the National ENT Trainee Research Network).[3] However, Fullerton found electrocautery to be superior to silver nitrate application.[14] The electrocautery he described was in fact in the form of galvanocautery – the heating of a wire to a red heat over an electric coil which was then applied topically. If a coil was not available, he suggested using a spirit lamp instead.[14]

In London in 1879, an epistaxis case was described in which haemorrhaging continued after the anterior nares plugging was removed. There was a small septal ulcer found upon inspection, to which a silver nitrate stick was applied to cease the haemorrhage.[15] This demonstrates that silver nitrate sticks were in use as early as 1879. A similar case occurred in New York, in 1880,[15] and in Pittsburgh, in 1884, wherein a silver nitrate stick was used alongside other astringents including salicylate of zinc, glycerol of tannic acid, chromic acid and tannate of iron.[16] This appears to be around the time that silver nitrate usage in epistaxis was becoming commonplace, as described in Prague, in 1887.[17]

A study by Stewart, which covered epistaxis management from 1912 to 1957, described the use of silver nitrate sticks in the cauterisation of active epistaxis at the Royal Infirmary Edinburgh; it was not utilised as a mainstay of treatment however.[18] The paper describes using a hot or cold saline douche, applied with a syringe, alongside ribbon gauze for packing, which was soaked in hydrogen peroxide for haemostasis, and the use of a 'Rose-Cooper' inflatable bag to exert pressure upon the bleeding point.[18] Stewart also makes reference to an epistaxis treatment, used in 1769, which involved immersing the genitalia into cold water, perhaps to promote vasoconstriction? Similar to this, there are reports of cold metal being placed over the cervical sympathetic ganglion.[18]

By 1974, silver nitrate cautery had established itself as a key part of epistaxis management. It was the fifth most used epistaxis treatment in a study of 1724 patients, behind anterior packing, posterior packing, blood transfusion and the Stevens balloon.[19] The Stevens Nasal Balloon seems to be similar to the Rapid Rhino™ nasal tamponades that are used in practice today. Of interest, tamponading by means of a balloon was described as early as 1851.[20] Posterior packing was repeatedly favoured in the late nineteenth century and was popularised with the use of a Belloq sound (an instrument used for plugging the nasal cavity) – debated to have been invented in the 1700s.[21]

Silver nitrate concentration

In Philadelphia, 1895, epistaxis treatment with silver nitrate was described as a '5 to 10% solution of silver nitrate applied on a small swab to the bleeding surface and held in position'. This differs from the silver nitrate sticks used in practice today.[22]

Chemical cauterisation used today requires visualisation of the bleeding point.

Cocainisation was originally used as a vasoconstrictor, prior to the implementation of other methods such as silver nitrate.[23] In the present day, adrenaline or xylometazoline are commonly used instead.

A step down to 4 per cent silver nitrate solution was noted in Atlanta, in 1933,[24] a reduction from the 5–10 per cent aforementioned solutions used in 1895.[22] Silver nitrate solutions as high as 50 per cent were noted in the treatment of epistaxis.[25] In 1932, 75 per cent silver nitrate sticks were available for use for epistaxis.[26] Given the silver nitrate sticks used in today's practice, it is difficult to compare the current treatment with the historical version; however, it is suggested that a 75 per cent concentration is superior to a 95 per cent concentration, as it seems to be more effective in the early stages, whilst causing less pain and fewer side effects.[27,28] Nonetheless, despite best efforts, there does seem to be a gap in the literature regarding how we went from using silver nitrate solution at 4–50 per cent to routinely using 75 per cent silver nitrate sticks.

Interestingly, the British National Formulary does not list epistaxis as an indication for the use of silver nitrate. Furthermore, epistaxis treatment is not mentioned in the product information

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for the Avoca silver nitrate stick, a product available from the UK supplier Bray Healthcare (Oxford, UK).

Mechanism of action

As previously mentioned, silver nitrate has been used throughout history for a range of different pathologies, but the question remains, why? What properties of silver nitrate have made it a versatile treatment over the years, and why is it particularly useful in epistaxis management?

There seems to be a lack of clear research into the mechanism of action of silver nitrate in epistaxis. An interesting article response published in 2008 highlights this, even stating 'we have hit a brick wall!'.[29] Some may argue that inductive reasoning should be sufficient over understanding the true action of the drug.[29,30] Even the manufacturers of silver nitrate sticks (Bray Healthcare) have been unsure of how their product works.[29] For this reason, they cannot provide any evidence for the concentrations used for epistaxis either.

Although there is no direct research investigating the mechanism of action, there is no reason why we cannot hypothesise how silver nitrate exerts its effects in epistaxis. A leading theory is that silver nitrate acts as an oxidising agent. Ag(I) (the cation) reduces to Ag(O) (neutral silver metal); this then precipitates and leads to the release of free radicals. This free radical production results in oxidation of organic matter, which coagulates tissues and kills bacteria.[31] The tissue is effectively being burned in this process.[32]

As per Fullerton, other means of chemical cauterisation have been used over the years, such as chromic acid.[14] Trichloroacetic acid was also used in the US army around 1954.[33] This would support the idea that the acidic properties of silver nitrate are responsible for its effects in epistaxis management. Another hypothesis is that silver ions can react with proteins to form nitrites or ammonia, which leads to thrombosis and tissue denaturing.[29]

Although a tissue study has been performed fairly recently to assess the effects of silver nitrate on nasal septal cartilage, viable mucosa containing the offending vessels was not included.[34]

Conclusion

Although silver nitrate is a mainstay of epistaxis treatment, its use seems to have developed over nearly 200 years based on evidence from individual case reports using different chemical acid agents. It remains unclear why silver nitrate became the preferred caustic agent used in the nose to treat epistaxis. It is also unknown as to why a 75 per cent concentration of silver nitrate is preferred over a lower concentration. Despite the reports above favouring electrocautery over chemical cautery, we seem to have preferred the latter; this could be associated with cost, availability, ease of use, staff training needs and clinical safety precautions.

As epistaxis remains a common ENT emergency presentation, and much of our mainstay of treatment remains as described by Fullerton over 120 years ago, we call upon all centres to rethink our approach in managing this extremely common condition and highlight the need to consider alternate novel first-line therapeutic options.

Competing interests. None declared

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