Emergency medicine myths and misconceptions: evaluating the evidence

ABSTRACT

Medical reversal is common, with rates of reversal of practices that were considered standard of care as high as 40%. Unfortunately, many standards of care are never tested, but instead are often promoted based on pathophysiological explanations or simply being long-established practices. Much of medical practice is based on dogma: a set of principles laid down by authority as incontrovertibly true. This article evaluates four commonly taught dogmatic practices in emergency medicine to determine if they are supported by the medical literature or are instead myths and misconceptions: (1) topical anaesthetics inhibit corneal healing, (2) treatment of myocardial infarction is MONA (morphine, oxygen, nitrates, aspirin), (3) children do not get sprains because their ligaments are stronger than bone, and (4) vagal manoeuvres for supraventricular tachycardia never work in adults. Medicine is changing all the time, and the best way to ensure that one is practicing medicine that is accurate, up to date and not prone to being reversed is to always be sceptical and to learn how to read and interpret the medical literature.

Dave Sackett, the father of evidence-based medicine, said: 'Half of what you'll learn in medical school will be shown to be either dead wrong or out of date within five years of your graduation; the trouble is that nobody can tell you which half – so the most important thing to learn is how to learn on your own.' While his statement may be considered hyperbole, there is good evidence to suggest it is actually closer to the truth. Prasad et al (2013) performed a 10-year review of original articles published in the *New England Journal of Medicine*. Of 363 articles that tested a standard of care, 40% (146) reversed the practice and only 38% (138) reaffirmed it. In other words, 40% of practices that were considered standard of care were wrong. This list includes the routine use of pulmonary artery catheters, intensive glucose lowering in type 2 diabetes, stenting in stable coronary artery disease, arthroscopic surgery for knee osteoarthritis, and vertebroplasty for osteoporotic fractures.

Prasad et al (2012) wrote an editorial about this phenomenon. Unfortunately, many standards of care are never tested, but instead are often promoted based on pathophysiological explanations or simply being long-established practices. It is possible that some entire medical subspecialties are based on little evidence. Much of medical practice is based on dogma: a set of principles laid down by authority as incontrovertibly true. The term is originally derived from the Greek terms dokein, which means 'to seem good', and dogma, meaning 'that which one thinks is true'. While the underlying intention of dogma may be good, it is incredibly problematic. Incorrect established medical practices expose patients to all the risks, potential harms and unjustified costs of treatment with no real benefit. This article evaluates four commonly taught dogmatic practices in emergency medicine to determine if they are supported by the medical literature or are instead myths and misconceptions.

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Topical anaesthetics inhibit corneal healing

Rosen's Emergency Medicine (Marx et al, 2013) states that topical anaesthetics 'inhibit wound healing. [They] should never be prescribed as pain medication.' There is concern that the use of topical anaesthetics can result in the development of keratitis, corneal ulceration and permanent corneal damage. These concerns initially developed because of animal studies on rats (Marr et al, 1957) and rabbits (Chang et al, 2006) demonstrating the toxic effects of topical anaesthetics on the cornea. However, it is important to remember that extrapolating such results to humans is inappropriate, as rabbits have a reduced blinking rate compared to humans. The evidence against the use of topical anaesthetics in humans comes only from case reports and case series. Epstein and Paton (1968) described five patients who developed keratitis after using topical anaesthetics for periods of 5 days to 2 months with a frequency of every 16 minutes to every 1 hour. Willis and Laibson (1970) reported on nine patients who developed corneal ulceration after using topical anaesthetics for up to 10 weeks with a frequency of every 15 minutes to every 2 hours. While this is not an exhaustive review, the literature reporting corneal damage in humans is limited to cases of inappropriate use of topical anaesthetics for an inappropriate length of time. The logical conclusion from these data is that chronic topical anaesthetic abuse may cause corneal damage.

Photorefractive keratectomy is an ophthalmological procedure that permanently changes the shape of the anterior central cornea to correct a person's vision. Photorefractive keratectomy removes the corneal epithelium, essentially causing a surgically-induced corneal abrasion. There have been four studies (Verma et al, 1995, 1997; Shahinian et al, 1997; Brilakis and Deutsch, 2000) that have assessed the effectiveness of topical anaesthetics in these patients, with a total of 141 patients. Patients who used topical

anaesthetics had significantly better pain control, and there were no complications of corneal damage.

There are several emergency department studies of patients with corneal abrasions. Ball et al (2010) enrolled adult patients with corneal injury in a prospective randomized controlled trial, randomizing patients to either 0.05% dilute proparacaine or placebo drops. They assigned 15 patients to the proparacaine group and 18 patients to the placebo group. The proparacaine group had significantly better pain reduction, and no ocular complications or delayed wound healing were seen in either group.

Waldman et al (2014) performed a prospective, double-blind randomized controlled trial of adults with simple uncomplicated corneal abrasion, randomizing patients to either 1% tetracaine or placebo saline drops, up to 24 hours after their emergency department assessment. Their main safety outcomes were repeat emergency department exams at 48 hours with fluorescein staining and slit lamp exam, 1-week and 1-month telephone interviews, and monitoring of charts for complications. They enrolled 59 patients in the tetracaine group and 57 in the saline group. There were no complications attributed to topical anaesthetic use and no difference in fluorescein uptake or symptoms at 48 hours. Tetracaine was rated as significantly more effective than saline. Because of the small numbers of enrolled patients, the 95% confidence interval for a complication being specifically caused by topical anaesthetic use was between 0% and 6.1%.

Based on this study, their emergency department changed its policy to allow physicians to use topical tetracaine for 24 hours as pain treatment for patients with simple corneal abrasions. Waldman et al (2018) subsequently reviewed 459 instances of tetracaine use, 303 of which were simple corneal abrasions, and 141 which were non-simple. There were no serious complications or adverse events attributed to tetracaine use in either simple or non-simple corneal abrasions. The only concerning finding was an increased risk of emergency department rechecks and persistent fluorescein staining among patients with non-simple corneal abrasion. However, these patients were inappropriately dispensed tetracaine in the first place.

While the data supporting the safety of topical anaesthetics in the emergency medicine literature are limited, there is also no compelling evidence in the literature that demonstrates corneal damage secondary to an appropriately used, short course of topical anaesthetics. It is therefore reasonable to prescribe a short course (less than 24 hours) of topical anaesthetics to reliable patients with simple corneal abrasions (who will not abuse or misuse topical anaesthetics with regards to frequency or duration of use).

Treatment of myocardial infarction is MONA

The acronym MONA is commonly taught as the treatment for myocardial infarction: morphine, oxygen, nitrates, aspirin. The 2013 American Heart Association guideline for the management of ST elevation myocardial infarction (O'Gara et al, 2013) states that 'oxygen therapy is appropriate for patients who are hypoxemic (O_2 sat <90%) and may have a salutary placebo effect in others.' This seems to intuitively makes sense as myocardial infarction and myocardial ischaemia occur as a result of an imbalance between oxygen supply and demand.

However, a more recent study should make clinicians reconsider this approach and think of oxygen as a drug. Stub et al (2015) performed a multicentre, prospective randomized controlled trial of patients with ST elevation myocardial infarction diagnosed on paramedic 12-lead electrocardiogram. Patients were randomized to either oxygen at 8 litres/min or no supplemental oxygen. The oxygen arm had 218 patients and the no oxygen arm had 223 patients. While the mean peak troponin level was similar in both groups, the mean peak creatine kinase level was significantly higher in the oxygen group (1948 *vs* 1543 U/litre). Of greater concern was that all secondary outcomes were significantly higher in the oxygen group. The oxygen group had a higher rate of recurrent myocardial infarction (5.5% *vs* 0.9%) and an increased frequency of cardiac arrhythmia (40% *vs* 31%). At 6 months, the oxygen group also had a larger infarct size on cardiac magnetic resonance imaging.

Hyperoxia appears to also cause harm in other clinical settings, including the intensive care unit. Girardis et al (2016) ran a single-centre randomized controlled trial of all adult patients admitted to an intensive care unit with an expected length of stay of greater than 72 hours, randomizing patients to either conventional oxygen use (O_2 saturation target 98–100%) or conservative oxygen use (O_2 saturation target 95–97%). They enrolled 218 patients in the conventional oxygen group, and 216 in the conservative oxygen group. The primary outcome was intensive care unit mortality, and the conservative oxygen group had significantly lower mortality (12% *vs* 20%). All secondary outcomes, including episodes of shock, liver failure and bacteraemia, were lower in the conservative oxygen group.

Chu et al (2018) confirmed this finding with a systematic review and meta-analysis of acutely ill adult patients requiring hospital admission who were randomized to either liberal or conservative oxygen strategies. They ultimately included 25 randomized controlled trials with 16 037 patients and found that a liberal oxygen strategy increased mortality both in-hospital (relative risk 1.21) as well as at longest available follow up (relative risk 1.10).

High levels of oxygen can potentially cause morbidity via superoxides and free radical formation. There seems to be toxicity related to hyperoxia in the setting of ST elevation myocardial infarction. Moreover, hyperoxia also seems to cause toxicity in other clinical situations including the intensive care unit, cardiac arrest and brain injury. In summary, hyperoxia is dangerous to patients, so supplemental oxygen should only be applied if the patient is actually hypoxic.

Children do not get sprains because their ligaments are stronger than bone

Rosen's Emergency Medicine (Marx et al, 2013) states: 'because it is composed of cartilage, the growth plate is the weakest part of the bone and is more likely to separate before adjacent tendon or ligaments tear. Accordingly, sprains are less frequent in the pediatric population than in the adult population.' Because paediatric patients have open growth plates, the Salte r–Harris classification system is used to describe fractures involving the growth plate of a bone. Salter–Harris fractures involving the growth plate with some combination of the metaphysis or epiphysis are fairly self-evident on X-ray. However, Salter–Harris 1 fractures cause some angst among clinicians, as they are transverse fractures through the growth plate. Unfortunately, this means that X-rays are negative, but the patient has point tenderness over the growth plate. There is concern that failure to diagnose and appropriately treat Salter–Harris 1 fractures could lead to morbidity in the form of growth arrest.

Boutis et al (2016) performed a prospective cohort study of children aged 5–12 years with an isolated lateral ankle injury that were clinically presumed to have a Salter–Harris 1 distal fibula fracture. All children had X-rays demonstrating open physes and absence of fracture. They enrolled 135 children and performed bilateral ankle magnetic resonance imaging within 1 week of injury. Of this cohort, only 3% (four patients) had magnetic resonance imaging-confirmed Salter–Harris 1 distal fibula fractures. The vast majority (80%) had ligament injuries, and 22% had isolated bone contusions. There was no difference in functional activity at 1- and 3-month follow up, and all children had fully recovered by 3 months.

In an accompanying editorial, Gill and Klassen (2016) summarized that 'in children with presumed Salter–Harris 1 distal fibula fracture, 33 children would need cast immobilization to treat one true Salter–Harris 1 distal fibula fracture with no effect on clinically important outcomes.' Unlike number needed to treat, which is the average number of patients who need to be treated to prevent one additional bad outcome, this is a number needed for futility. Furthermore, there are no reported cases of growth arrest in isolated, non-displaced Salter–Harris 1 fractures.

It was previously thought that sprains are uncommon in the paediatric population because of the presence of the growth plate. Newer evidence disproves this myth and shows that lateral ankle sprains are actually quite common in children. These patients can be managed with a removable brace and allowed to return to activities as tolerated.

Vagal manoeuvres for supraventricular tachycardia never work in adults

Rosen's Emergency Medicine (Marx et al, 2013) remarks that: 'vagal maneuvers usually fail to terminate supraventricular dysrhythmias but rarely cause deterioration.' Supraventricular tachycardia is a dysrhythmia characterized by abrupt onset, regular rate that usually exceeds 150 beats/minute, and lack of identifiable P waves on electrocardiogram. Supraventricular tachycardia is caused by an abnormal circuit that allows a wave of depolarization to repeatedly travel in circular fashion in cardiac tissue via a reentry circuit that may reside in the atrioventricular node or outside the atrioventricular node in an accessory pathway. The goal of treatment is to terminate this circular depolarization. Although vagal manoeuvres are the preferred initial therapy, published literature shows that cardioversion is rarely successful with these manoeuvres in adults, with conversion rates less than 20% (Lim et al, 1998).

As a result, adenosine is the treatment of choice for supraventricular tachycardia. Many practitioners do not bother attempting vagal manoeuvres and go straight to administering adenosine. Although it is safe, it results in transient asystole and a feeling of imminent death that many patients find unpleasant and frightening.

Appelboam et al (2015) performed a randomized controlled trial in adult patients presenting with supraventricular tachycardia, randomizing patients to either a modified Valsalva manoeuvre or a standard semi-recumbent Valsalva strain. They randomized 214 patients to each group.

The modified Valsalva manoeuvre is performed by having the patient perform a forced expiration on a manometer to a pressure of 40 mmHg for 15 seconds while in a semi-recumbent position. Having the patient blow into a 10 ml syringe in an attempt to just move the plunger generates a similar pressure. The patient is then laid supine and the legs are raised in the air for 15 seconds. This modification to the Valsalva manoeuvre resulted in significantly higher conversion rates compared to the standard Valsalva group (43% *vs* 17%). There were no serious adverse events.

Çorbacıoğlu et al (2017) affirmed this finding in a more recent smaller randomized controlled trial where patients were randomly assigned to a modified Valsalva group and a standard Valsalva group. Instead of using a manometer to help participants achieve a specific Valsalva strain pressure of 40 mmHg, they instructed patients to blow into a 10 ml syringe to move the plunger. They assigned 28 patients to each treatment arm. The modified Valsalva group again had a significantly higher conversion rate compared to the standard Valsalva group (43% *vs* 11%).

The modified Valsalva manoeuvre is a simple alteration to standard vagal manoeuvres that is free, safe, effective, does not require an intravenous line, and can be taught to patients. For cooperative haemodynamically stable patients, this should be the first treatment attempted in adults with supraventricular tachycardia.

Conclusions

Dave Sackett also said: 'Remember that your teachers are as full of bullshit as your parents.' Medicine is changing all the time. How do we practice medicine that is accurate, up

to date and not prone to being reversed? How do we avoid following medical dogma that may actually be incorrect? Remember to be sceptical. Ask questions, and never accept 'that's the way it is' as an answer. Most importantly, learn how to read and interpret the medical literature, and ultimately decide for yourself. **BJHM**

Dr DJ Kim has presented this as an invited lecture at the University of British Columbia 52nd Annual Post Graduate Review in Family Medicine in Vancouver, British Columbia, Canada on 25 February 2017, the Canadian Association of Emergency Physicians 2017 Annual Conference in Whistler, British Columbia, Canada on 5 June 2017 and the International Conference on Emergency Medicine 2018 in Mexico City, Mexico on 5 June 2018. Conflict of interest: Dr DJ Kim is on the medical advisory board for Clarius Mobile Health and has received stock options for this advisory role. This role is unrelated to this article.

KEY POINTS

- There is no compelling evidence in the literature demonstrating corneal damage secondary to an appropriately used, short course of topical anaesthetics. It is reasonable to prescribe a short (less than 24-hour) course of topical anaesthetics to reliable patients with simple corneal abrasions.
- Hyperoxia seems to cause toxicity in the setting of myocardial infarction, as well as in other acutely ill patients in clinical settings like the intensive care unit, cardiac arrest and brain injury. Hyperoxia is dangerous to patients, so supplemental oxygen should only be applied if the patient is actually hypoxic.
- Historically, there has been concern about paediatric ankle injuries because of the presence of the growth plate. Newer evidence shows that lateral ankle sprains are actually quite common in children, and these patients can be managed with a removable brace and allowed to return to activities as tolerated.
- The modified Valsalva manoeuvre involves lying a patient supine with the legs raised in the air for 15 seconds after 15 seconds of a Valsalva strain in a semi-recumbent position. This simple alteration is free, safe, effective, and should be the first treatment attempted in haemodynamically stable, cooperative adults with supraventricular tachycardia.
- The best way to ensure that one is practicing medicine that is accurate, up to date, and not prone to being reversed is to always be sceptical and to learn how to read and interpret the medical literature.

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