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CLINICAL

Painless vascular cannulation: ethyl chloride, vapocoolants and cryoanalgesics

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TITLE The effect of vapocoolant spray on pain due to intravenous cannulation in children: a randomized controlled trial

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SUMMARY

The insertion of intravenous cannulae causes significant pain and in children leads to an uncooperative child, failed first attempts, prolonged procedures and anxious and dissatisfied parents. Although a number of behavioural and pharmacological approaches are possible, including distraction, topical local anaesthetics, subcutaneous injection of local anaesthetics and systemic anaesthesia, they are all time-consuming and often impractical in the outpatient setting. This has led to the continuous development of novel minimally invasive systems for producing local analgesia[1] and repeated attempts to resurrect the use of coolant sprays and powders. This paper revisits the use of vapocoolant sprays or so-called cryoanalgesics, which induce skin cooling by rapid evaporation and reduce pain by inhibiting conduction in the small superficial pain fibres.

In this double-blind randomised controlled trial, 80 children aged between 6 and 12 years received either a vapocoolant spray, 'Pain Ease' supplied by Gebauer Company, or a placebo, 'Nature's Tears' by Bio-logic Aqua Technologies, a sterile normal saline spray at room temperature. The children rated their pain using a 100-mm coloured visual analogue scale (VAS). Secondary outcomes included the success rate for cannulation at the first attempt and assessments by the children's parents, nurses and child specialists.

The highly detailed results show a number of modest but significant advantages of the vapocoolant over the placebo, including a reduction in the children's analogue scores of 19 mm. Perhaps a more meaningful result was that about 18% more children, seven of 40, in the treatment arm reported feeling no pain or minimal pain. In addition, there was an improvement in the first attempt of cannulation from 62.5% to 85%, i.e. the prevention of one failed first attempt would require five children to be treated. Perhaps the most important finding was that parents, nurses and child specialists believed that the use of the vapocoolant reduced the children's pain. No immediate or delayed adverse events were recorded.

OPINION

This was a nicely designed study with many features one would only expect to find in larger, commercially funded studies. A sample size of 68 was chosen on the assumption that a reduction in the analogue scale of 15 mm would be significant, and 80 patients were recruited to compensate for dropouts. In addition, the authors used a linear regression model to correct for the variance in cannula size.

During the application of the sprays, the nurses, parents and child health specialists were asked to look away, and the vapocoolant spray was used from a distance of 8–18 cm for 4–10 seconds until the skin blanched. The placebo was used in 'a similar fashion'. It is not reported whether the skin blanched or not during the application of the placebo of normal saline. This may be important since parents correctly identified which spray was given on 79 occasions, the nurses on 52 and the child specialists on 65. Unfortunately the patients were not asked to guess. Although the nurses were frequently changed, the same two child health specialists were used throughout. The possibility that the vapocoolant could be identified by smell is not discussed. However, the British Oxygen Company (BOC) describes the odour of one of the ingredients as slight and ethereal. Nature's Tears, the placebo, contains no additives and is propelled from an inner sealed bag by nitrogen at pressure in the surrounding can.

The results suggest that a vapocoolant can provide a quick and effective reduction in pain due to intravenous cannulation without delaying the procedure. Pain Ease contains 1, 1, 1, 3, 3-pentafluoropropane and 1, 1, 1, 2-tetrafluoroethane, and is described as a non-flammable, non-toxic and ozone-friendly spray. This is important as one might expect that similar levels of local anaesthesia can probably be obtained with ethyl chloride.

However, a similarly careful study[2] describes another randomised trial in adult patients, with an average age of 49, in which the reduction in pain during intravenous cannulation was compared after four different treatments: no treatment, intradermal 1% lignocaine 0.1 ml, ethyl chloride topical spray and inhalation of entonox (50:50 oxygen and nitrous oxide). There were in excess of 69 patients in each group, and a sample size of 25 was calculated as necessary to detect a change of 10 mm. Although intradermal lignocaine was shown to cause a small but significant effect on the VAS scale of 20 mm, the reduction caused by ethyl chloride was 11 mm and failed to reach significance. In passing, it is interesting to note that in this study the gauges of cannulae 21, 20, 18 or 16 were all larger than those used in the paediatric study. The failure in this adult study to detect an analgesic action of ethyl chloride contradicts at least two earlier studies,[3,4] but is probably in agreement with other more recent studies that show no significant effect.[5,6] However, I suspect both these studies were underpowered when compared with the two main studies described above.

Peripheral venous cannulation and arterial blood gas sampling are two of the most common invasive procedures carried out on patients. Both can be very painful, and numerous studies have shown that most of the pain can be avoided by the optimal use of local anaesthetics. However, a recent study[7] has confirmed a number of earlier studies that show that for the insertion of large bore cannulae, larger than 20G, all anaesthetists used local anaesthesia but only 30–40% of surgeons and physicians. The difference was even more striking when considering arterial blood gas sampling, where almost all anaesthetists used local anaesthetics and less than 2% of the physicians and surgeons. The interpretation of this study is not straightforward since those classified as non-anaesthetists were nearly all junior doctors and their failure to limit the pain endured by their patients could be a reflection on their training and, perhaps, the teaching of cannulation on manikins. In addition, in many hospitals venepunctures are now carried out by phlebotomists rather than junior doctors. Table 1 contains the recommendations[8] for the use of local anaesthesia described in the editorial that accompanied the above paper.

Although the analgesic effect of vapocoolants may be minimal and their use prior to the intradermal injection of a local anaesthetic may be over the top, the use of preparations such as Pain Ease, containing non-toxic, non-flammable, eco-friendly and relatively cheap gases developed as refrigerants is preferable to the use of ethyl chloride. The manufacturer of ethyl chloride in the US issues the following warnings (extracted from the Material Safety Data Sheet):

> EMERGENCY OVERVIEW: Ethyl Chloride is a colorless, liquefied, flammable gas. Ethyl Chloride has a pungent, ether-like odor and is mildly toxic by inhalation, with a narcotic effect. Inhalation of the gas can cause central nervous system depression. Symptoms of such overexposure can include headache, nausea, dizziness, drowsiness. Inhalation of high concentrations can be fatal. Exposure to the gas may also be irritating to the skin, eyes and mucus membrane irritant. Ethyl Chloride reacts with water or steam to produce hydrochloric acid, which is toxic and corrosive. Both the liquid and gas pose a serious fire hazard when accidentally released. The gas is heavier than air, and may spread long distances. Distant ignition and flashback are possible. Rapid evaporation of liquid from cylinder may cause frostbite.

TABLE 1 Recommended method for the painless injection of local anaesthetic before venous cannulation

1. Allow alcohol cleanser to dry completely.
2. Draw up 1 ml lidocaine 1% into a 2-ml syringe and attach a 25 gauge (orange) needle.
3. Position the needle above the injection site so that the bevel is parallel to the skin.
4. Firmly press the bevel flat against the skin with the thumb of the non-dominant hand, while applying constant pressure to the plunger of the syringe with the dominant hand.
5. Very slowly, advance the needle (with the bevel still parallel to the skin and still applying pressure to the plunger) until a small white bleb begins to appear within the skin. Stop advancing the needle but continue to inject slowly until the bleb grows to about 4–5 mm.
6. Further lidocaine can be slowly injected under the skin if the vein is deep; otherwise the intradermal bleb will be adequate for cannulation of a superficial vein.
7. The cannula can now be advanced painlessly through the skin.

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