EFFECT OF A EUTECTIC MIXTURE OF LOCAL ANAESTHETIC AGENTS (EMLA) ON TOURNIQUET PAIN IN VOLUNTEERS

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The use of a pneumatic tourniquet to facilitate limb surgery is often complicated by the development of tourniquet pain. Various methods have been used to alleviate this pain, but most have proved unsatisfactory [1].

The local anaesthetic cream EMLA (Astra) (a 5 % eutectic mixture of lignocaine and prilocaine) has been used widely to provide cutaneous analgesia for venepuncture [2] and for cutting split-skin grafts [3]. Despite the considerable areas of skin covered in this application, systemic toxicity has not been reported [3].

The present study was designed to evaluate the effect of EMLA in attenuating tourniquet pain.

METHOD AND RESULTS

Ten healthy male volunteers (aged 24–36 yr) were studied in a double-blind, randomized, placebo controlled, crossover trial. Local Ethics Committee approval was obtained and the volunteers gave informed written consent. Subjects who smoked, were more than 125 % ideal body weight or had a history of diabetes, hypertension, sickle cell disease, skin problems or allergy to local anaesthetic agents were excluded. The study sessions for each subject were 1 week apart, with the exception of two subjects who were studied after an interval of 2 weeks.

EMLA 50–60 g or a visually and cosmetically identical placebo was applied circumferentially to the non-dominant upper arm and covered by an occlusive dressing 2 h before the study.

The subject was settled comfortably in a reclining position, and was unable to see clocks or monitoring equipment. An indwelling cannula was placed in a vein on the dorsum of both hands. An 8-cm tourniquet cuff (Schuco tournicuff) was applied over a double layer of plaster wool (velband) and occlusive dressing, to be positioned directly over the area of skin covered by cream. Systemic arterial pressure was measured non-invasively at 5-min intervals on the opposite arm (Spacelab 90601). The ECG was displayed continuously.

Tourniquet pain was assessed by means of a 100-mm visual analogue scale (VAS), one end of which represented no pain and the other end the worst pain imaginable. VAS were recorded at 5-min intervals.

Following a 10-min period of stabilization, the arm was exsanguinated by elevation and the tourniquet inflated to the systolic pressure + 100 mm Hg. Prilocaine (0.25 %) 0.5 ml kg^{-1} was injected into the isolated forearm.

Termination of the study was at the request of the subject when the pain under the tourniquet became intolerable.

Data were analysed using paired t test and Wilcoxon rank sum test as appropriate; all results are expressed as mean (SEM).

SUMMARY

We studied the effects of EMLA on tourniquet pain in 10 healthy male volunteers. The tourniquet inflation time which was tolerated was significantly longer with EMLA (46.4 (SEM 3.5) min) compared with placebo (37.5 (2.7) min) (P < 0.05). Linear analogue pain scores increased in both groups over the study period, but were significantly less in the EMLA group at 40 min (P < 0.05). We conclude that tourniquet pain has a significant cutaneous component.

The duration of the tourniquet inflation tolerated in the EMLA group was 46.4 (3.5) min, compared with 37.5 (2.7) min in the placebo group ($P < 0.05$). In eight of 10 subjects the tourniquet was tolerated longer with EMLA compared with placebo cream (fig. 1). The randomization resulted in the order of application of EMLA and placebo cream being equivalent. There was no significant difference between the tourniquet time tolerated of the first compared with the second application.

VAS scores were comparable in both groups before inflation of the tourniquet (placebo 3.0 (0.7) mm, EMLA 3.1 (0.4) mm) and although they increased in both groups over the study period they were lower in the EMLA group; the difference at 40 min (placebo 73.33 (4.9) mm, EMLA 42.43 (6.9) mm; $n = 6$) was significant ($P < 0.05$) We did not observe any significant change in heart rate or systemic arterial pressure associated with the increase in VAS.

COMMENT

The mechanism of tourniquet pain is still poorly understood, but is probably multifactorial [4]. It is experienced usually 30–60 min after inflation of a tourniquet and disappears invariably and promptly on deflation.

Cole [5] suggested that tourniquet pain had both a superficial and a deep component and may be caused by compression or possibly ischaemia of large nerves; he believed it was autonomic in origin and of sufficient intensity to penetrate a spinal block. The role of the autonomic system has been disputed by Farah [1], who demonstrated the occurrence of tourniquet pain during i.v. regional analgesia (IVRA) of the upper limb despite stellate ganglion block. Rouss [6] also proposed that skin compression is an important component of tourniquet pain.

This study was designed to be double-blind, but application of EMLA cream produced blanching or reddening of the skin in some subjects. However, these changes were noticeable only after the cream had been removed at the end of the first study period. The observer was blind on each occasion. The use of IVRA was initiated during a small pilot study; the use of prilocaine allowed subjects to differentiate ischaemic pain of the arm from tourniquet pain.

It is possible that both lignocaine and prilocaine may affect the pain threshold by a central effect. Ohlsen, Englesson and Evers [3] measured the plasma concentrations of lignocaine and prilocaine in 106 patients after application of EMLA for split-skin grafting. They covered areas of skin up to 1000 cm$^2$ for up to 7 h. The plasma concentrations of lignocaine and prilocaine were $\leq 1100$ ng ml$^{-1}$ and $\leq 200$ ng ml$^{-1}$, respectively. These are significantly less than those observed after brachial plexus block using 400 mg of either agent (lignocaine 2500 ng ml$^{-1}$ and prilocaine 4500 ng ml$^{-1}$). The area of skin covered in this study was approximately 300 cm$^2$ (arm circumference $\times$ width of tourniquet) and it is unlikely that sufficient lignocaine or prilocaine was absorbed to exert a central analgesic effect, even if absorption was altered by the inflation of the tourniquet.

The significant increase in the mean tourniquet time tolerated with EMLA and the apparent decrease in the severity of the pain felt under the cuff with EMLA may be of limited clinical relevance; however, this study does help to elucidate the nature of tourniquet pain and suggests that there is a small but significant cutaneous component to this phenomenon.

ACKNOWLEDGEMENT

We thank Astra Pharmaceuticals for supplying the EMLA and the placebo cream.

REFERENCES