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Don't Forget the Bubbles

Making a difference: pragmatic paediatric pain management

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One of the great rewards of paediatric emergency medicine is the opportunity to manage the pain of a suffering child and in doing so provide welcome relief to a family in distress. While there is no single analgesic recipe that is appropriate for all clinical situations there is a toolbox of interventions that allows us to reduce the pain in the vast majority of illnesses, injuries and medical procedures to a level which most children and families find acceptable. This paper aims to open that toolbox, explore its contents and demonstrate that, while many children still suffer from under-analgesia in Emergency Departments (1), the solutions to this disservice are not intimidating.

First do no harm

Some procedures undertaken in the Emergency Department provide low diagnostic yield. These include blood cultures and inflammatory markers being used for risk stratification of well-looking, immunised, febrile children (2) as well as blood tests to exclude appendicitis in children presenting with less than 24 hours of abdominal pain (3). In these circumstances, venepuncture could reasonably be replaced with a period of observation.

Other procedures have less painful alternatives - venepuncture is less painful for neonates than heel lancing (4). Venepuncture is well known to be less painful than arterial puncture and will provide equivalent information in many circumstances (5). Tissue adhesive is an option for repair of clean, simple, linear, low tension wounds negating the need for sutures.

We have previously written (6) about non-pharmacologic methods of reducing distress but emphasise here the importance of active distraction, deliberate communication strategies and caregiver involvement.

Sweet as...

While its mechanism of action and dosing regimen remain unsettled, the efficacy of oral sucrose in the young infant is well demonstrated (7). It may work via both opioid and non-opioid receptor pathways. Dosing recommendations vary from 0.5-5 mls of 24% sucrose given 2-5 minutes before the procedure with repeat doses as required (7).

Just a little prick

Topical anaesthesia has a role in most transcutaneous procedures including venepuncture, lumbar puncture and laceration repair. For application to unbroken skin prior to a procedure, options include eutectic mixture of local anaesthetics (lignocaine 2.5% and prilocaine 2.5% - EMLA), amethocaine (tetracaine /Ametop) and liposomal lignocaine (e.g. LMX4). EMLA has a recommended application time of 60 minutes before venepuncture and carries the risk of methaemoglobinaemia in larger doses, limiting safe use to children over three months of age and 5 kg in weight (8).

Amethocaine and liposomal lignocaine need only be applied 30 minutes prior and do not carry the same risk of methaemaglobinaemia allowing their use in term babies. It is possible to develop local anaesthetic toxicity from all topical anaesthetics, so these agents should be used with care in infants. Amethocaine was more efficacious than EMLA in a Cochrane review of six studies (9). Some erythema was noted after amethocaine use and this is commonly seen in practice. It is not an allergy. Liposomal lignocaine and amethocaine are equivalent in effect (10). The short duration of onset, efficacy, and low cost of liposomal lignocaine has led to more hospitals selecting LMX4 as their topical analgesic of choice. We have had recurrent difficulties getting cannula dressings to stick to skin treated with LMX4, though washing the area prior to cannulation does seem to help.

With broken skin, combinations of local anaesthetic and adrenaline (e.g. LAT, Laceraine) can be used by saturating gauze and instilling it directly into the wound. This provides analgesia, haemostasis and also provides an insight into whether the child will tolerate wound closure without procedural sedation – often if they are co-operative with this part they will be fine during suturing. When it is time for wound repair, lignocaine should be buffered (11) (1 ml of 8.4% sodium bicarbonate with 9 mls of 1% lignocaine), warmed to room temperature and injected slowly using the smallest needle possible (ideally 27-30 g) into wound margins without piercing intact skin.

Pillars of salt and pillars of sand

Any analgesic plan should be constructed on solid foundations of 'simple' analgesia. Paracetamol has an opioid sparing effect (12) so makes a useful adjunct even in severe pain. The oral form reaches peak levels by 30 minutes but the rectal form is absorbed more erratically with a delayed onset, but longer duration of effect. (13) It should be dosed for lean body mass. It has been suggested to be both a precipitant of and protective against bronchospasm, but neither argument is yet convincing so we do not currently consider respiratory co-morbidity when prescribing paracetamol.

Non-steroidal anti-inflammatory drugs (NSAIDs) are effective against mild and moderate pain and form a useful component of multi-modal therapy. Ibuprofen is generally safe though concern exists regarding its effects on infant renal function. Glomerular maturation continues until about two years of age and single NSAID doses have been shown to *reversibly* reduce glomerular filtration rate by up to 20% in neonates (13). There is no consensus on the safe lower age limit for routine ibuprofen use but we do not use it under 3 months of age and use caution below 12 months. Dehydration will increase the risk of glomerular injury.

NSAIDs also cause reversible platelet inhibition, which is relevant in thrombocytopenic or otherwise coagulopathic states including anything that involves a petechial rash. The risk of gastritis, well described in adults, should be considered in children with chronic use. We use short courses of ibuprofen for fracture related pain as study of the clinical relevance of the

impairment of bone healing remains inconclusive (14,15). Non-steroidal anti-inflammatory drug exacerbated respiratory disease (NSAID ERD) means all drugs of this class should be used cautiously in severe asthmatics but we do not extend this concern to the majority of wheezy children.

Just say no!

Codeine is rapidly falling out of favour as an oral opioid. It is a prodrug requiring enzymatic conversion to its active form. Four phenotypes of codeine metaboliser exist and range from those unable to gain any analgesic effect at all from the drug to 'ultra-metabolisers' in whom the active form is made rapidly available. Deaths have been reported in ultra-metaboliser neonates whose breastfeeding mothers have taken codeine (16) as well as in older children (17). Distribution of phenotype differs amongst ethnic groups. Those of African and Arabic origin are at greatest risk of problematic metabolism (13). Codeine will (sensibly) cease to be available in Australia in over the counter preparations from early 2018 (18). Oxycodone offers a reliable and palatable option when an oral opioid is required and should be available in every paediatric emergency environment.

Pick the nose

Fentanyl's lipid solubility allows its use by a variety of routes, the most attractive of which is intranasal (IN). Intranasally, fentanyl has an onset of action of 2-5 minutes, comparable with its performance by the intravenous route (19). IN fentanyl has a slightly longer duration of

action than IV. It is excellent for providing rapid control when children present in severe pain. The standard dose of 1.5 micrograms/kg can be repeated if required. Delivery should be with a mucosal atomiser device (MAD). Aim up and laterally in the nostril, not directly backwards. The goal is to coat the mucosa, aiming straight back will lead to the liquid collecting in the nasopharynx before being swallowed, reducing its bioavailability. Larger volumes can be divided between the nostrils.

Ketamine has powerful analgesic properties at lower doses than those used for procedural sedation. When delivered intranasally via a MAD, doses of 1 mg/kg provide comparable analgesia to fentanyl dosed at 1.5 micrograms/kg (20). This is a particularly attractive option if there is a reason to avoid opioids or if the number of opioid doses are becoming a concern. The possibility of providing procedural sedation through the use of intranasal ketamine is currently being explored.

Pass the gas

Nitrous oxide offers a rapid onset of relief from mild to moderate pain. It can be used in concentrations of up to 70%. Combined with intranasal fentanyl, it provides more potent analgesia. It is deliverable via demand systems, which most children over five years of age can manage, or continuous flow systems suitable for younger children. Its low lipid solubility allows for rapid recovery times making nitrous oxide well suited for short and not severely painful procedures. Vomiting is the most common side effect, with headache, dysphoria and

restlessness also reported (21). Contraindications are mainly based on the risk of gas diffusion into closed spaces. It also interferes with vitamin B12 metabolism so we avoid its use in all children with inborn errors of metabolism.

While not exhaustive, this selection of tools can be used to deliver effective analgesia to children of all ages. Effective analgesia can improve procedural success rates (22), reduce long term psychological sequelae (23) and make consultations nicer for the patient, family and clinician.

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