

Pediatric Pain Letter

Abstracts and Commentaries on Pain in Infants, Children, and Adolescents

Editorial Board

Editors and Publishers

Patrick J. McGrath Ph.D.
G. Allen Finley M.D. FRCPC
Dalhousie University and IWK Grace Health Centre
Halifax, Nova Scotia, Canada

Editorial Board Members

H. Abu-Saad, Maastrich, The Netherlands
C. Berde, Boston, USA
D. Champion, Sydney, Australia
K. Craig, Vancouver, Canada
J. Eland, Iowa City, USA
M. Fitzgerald, London, U.K.
G. Frager, Halifax, Canada
P. Gaukroger, Adelaide, Australia
S. Hertel, Copenhagen, Denmark
C. Johnston, Montreal, Canada
G. Olsson, Stockholm, Sweden
J. Ritchie, Halifax, Canada
N. Schechter, Hartford, USA
A. Unruh, Halifax, Canada
C. von Baeyer, Saskatoon, Canada

Managing Editor

Julie Goodman, Psychology Department, Dalhousie University,
Halifax, Nova Scotia, B3H 4J1, Canada.
email: jgoodman@is2.dal.ca

Subscriptions

1-Year subscription is \$25 CAN in Canada, \$35 CAN or \$25 US in other countries. Payment can be made by cheque, money order, or credit card. Subscribe by sending us the enclosed subscription form or by sending payment and mailing address to the managing editor. The *Pediatric Pain Letter* is also distributed in Canada by Astra Canada.

Copyright © 1997 - P. J. McGrath & G. A. Finley / ISSN # 1205-9692

Table of Contents

Introduction	13
Abstracts	
Eutectic Mixture of Local Anesthetics	14
Patient-Controlled Analgesia	17
Recent Articles	20
Book Review	23
Announcements	24

Introduction

Welcome to the second issue of the *Pediatric Pain Letter*. This time we have commentaries on two aspects of pharmacological therapy for pediatric pain. Evidence is presented on the use of continuous infusions in conjunction with patient-controlled analgesia (PCA), and for specific bolus doses of opioids with PCA. We also examine a few of the many recent articles on the use of EMLA cream in infants and children.

Abstracted papers address some difficult areas of chronic pain (headache and the relation of emotional distress to pain) and acute pain (acute abdominal pain and management of procedural pain). We are also pleased to include a review of Leora Kuttner's new book for parents and professionals, *A Child in Pain: How to Help, What to Do*.

We are delighted that 2000 copies of our first issue have been distributed by Astra Canada, and that people from a diverse array of disciplines and specialties from 14 countries have subscribed to or requested the *Pediatric Pain Letter*. In future issues we plan to review the use of sucrose for neonatal analgesia, the influence of culture on pain, gender differences in pain prevalence, and circumcision, among other topics. We welcome your comments and suggestions.

Abstracts

Eutectic Mixture of Local Anesthetics (EMLA)

Taddio, A., Nulman, I., Goldbach, M., Ipp, M., & Koren, G. (1994). Use of lidocaine-prilocaine cream for vaccination pain in infants. *Journal of Pediatrics*, *124*, 643-648.

Objective. To determine the efficacy of 5% lidocaine-prilocaine cream (EMLA) on reducing pain from intramuscular vaccination in infants.

Design. Randomized, double-blind, placebo-controlled trial.

Setting. Pediatric outpatient clinic.

Participants. 96 (50% male) healthy infants receiving the 4- or 6- month diphtheria-pertussis-tetanus (DPT) vaccination.

Interventions. Infants were randomly assigned to one of two experimental groups. 49 infants received either 2.5 gm of EMLA and 47 received 2.5 gm of placebo cream which was applied by a parent to the infant's leg and covered with an occlusive dressing 60 minutes prior to the immunization. Each infant received a 0.5 mL intramuscular injection of DPT vaccine with a 1.6 cm 25-gauge needle.

Main Outcome Measures. A blinded investigator rated the infant's pain using a 100 mm Visual Analog Scale (VAS; 0 = no pain, 100 = maximal possible pain) within 15 seconds of the procedure. From videotape, a blinded, trained assistant rated the child's response using the Modified Behavioral Pain Scale (MBPS), the latency of the first cry, and startle response.

Results. Children who received EMLA had lower scores on the MBPS, the VAS, and had lower startle ratings during and after the procedure. Infants who received EMLA had a longer latency between the needle and the first cry, and cried less than infants who received placebo. Parent-rated infant temperament, as measured by the Carey Infant Temperament Questionnaire, was not related to the pain ratings. Female infants had higher pain ratings than males.

Conclusions. EMLA was effective in reducing the pain and crying from vaccination in infants, and its application was more predictive of the infant's reaction than temperament, age, and which physician administered the vaccination.

Halperin, D.L., Koren, G., Attias, D., Pellegrini, E., Greenberg, M.L., & Wyss, M. (1989). Topical skin anesthesia for venous, subcutaneous drug reservoir and lumbar punctures in children. *Pediatrics*, *84*(2), 281-284.

Objective. To evaluate the efficacy of a topical anesthetic cream for reducing pain associated with venepuncture, injections through subcutaneous drug reservoirs, and lumbar punctures.

Design. Randomized, double-blind, placebo-controlled trial.

Setting. Children's hospital.

Participants. 18 children receiving venepuncture (11 females; age range = 6.0 - 12.2 years), 8 children receiving subcutaneous drug reservoir puncture (4 females; age range = 6.1 - 15.1 years), 14 children receiving lumbar puncture (5 females; age range = 5.5 - 15.3 years) were randomly assigned to receive either EMLA or placebo cream. All children had malignant diseases and had been receiving chemotherapy for at least 6 months.

Interventions. 2 mL of EMLA 5% cream or placebo were applied and covered with an occlusive dressing. The EMLA was left on the target site for 30-90 minutes for the venepuncture group, for 60-175 minutes for the drug reservoir group, and for 60-100 minutes for the lumbar puncture group.

Main Outcome Measures. Child self-report obtained using 10 cm visual analogue scale (anchors 0 = no sensation; 10 = worst imaginable pain)

Results. EMLA-treated groups had lower VAS pain ratings than placebo-treated groups across all procedures (venepuncture: EMLA = 2.8, placebo = 6.8; drug reservoir: EMLA = 1.2, placebo = 3.9; lumbar puncture: EMLA = 1.9, placebo = 5.6). In the venepuncture group, pain ratings of children whose EMLA application lasted less than 30 minutes were higher than children whose EMLA application lasted more than 60 minutes.

Conclusions. EMLA was superior to placebo in alleviation of pain from these procedures. Because the cream should be applied for at least 60 minutes, it is not suitable for emergency procedures, but would significantly reduce pain associated with many planned in- hospital procedures.

Benini, F., Johnston, C.C., Faucher, D., & Aranda, J. V. (1993). Topical anesthesia during circumcision in newborn infants. *JAMA*, *270*(7), 850-853.

Objective. To evaluate the effectiveness of topical lidocaine-prilocaine cream (EMLA) in reducing pain from neonatal circumcision.

Design. Randomized, placebo-controlled trial.

Setting. Teaching hospital, normal newborn nursery.

Participants. 27, 1- to 3-day-old, healthy, full-term, male infants.

Interventions. 0.05 mL of EMLA cream or petroleum jelly was applied to the outside of the prepuce and covered with an occlusive dressing 45 to 60 minutes prior to circumcision. All circumcisions were requested by parents.

Main outcome measures. Heart rate and transcutaneous oxygen saturation were measured, facial activity was videotaped and coded using the Neonatal Facial-Action Coding System, and percentage of time spent crying was calculated for each phase of the procedure.

Results. All infants had increased heart rate, decreased oxygen saturation and facial actions during the procedure, as compared to baseline. Those infants who received EMLA had significantly lower heart rates (25 beats per minute lower) and 5% higher oxygen saturation throughout the procedure. Infants who had received EMLA also displayed 20% less facial action and 15% less crying during phases of the procedure. Spectral analysis of cry did not reveal group differences.

Conclusions. Although all infants experienced stress during the procedure, infants who received EMLA showed less pain as measured by physiological and facial responses. EMLA is an effective agent for reducing circumcision pain, and did not appear to cause side effects, but the authors caution that more study is needed on the safety and pharmacodynamics of EMLA in newborns before its use becomes standard practice.

Arts, S.E., Abu-Saad, H.H., Champion, G.D., Crawford, M.R., Fisher, R.J., Juniper, K.H., & Zeigler, J.B. (1994). Age-related response to lidocaine-prilocaine (EMLA) emulsion and effect of music distraction on the pain of intravenous cannulation. *Pediatrics*, 93(5), 797-801.

Objective. To compare the efficacy of EMLA to placebo and music distraction in reducing pain from venous cannulation. The effect of age on pain ratings was also examined.

Design. Randomized controlled trial.

Setting. Unspecified.

Participants. 180 children scheduled for surgery under general anesthesia participated (225 approached, 45 refused or were uncooperative in operating room; 80 females, aged 4-16 years; mean age = 9.7 years). About half had previous venous cannulation.

Interventions. The 3 interventions were EMLA cream, placebo cream, or music. A thick layer of EMLA cream or a placebo cream similar to EMLA in all characteristics was applied 1 hour before venous cannulation and covered with an

occlusive dressing. Appealing, upbeat music was played via earphones beginning just prior to the procedure. Both children and experimenter were blind to which cream was used.

Main Outcome Measures. Faces Pain Scale (Bieri et al., 1990). Visual Analogue Toy (20 cm wooden vertical pole with Koala toy; bottom of pole = no pain, top of pole = worst pain). Global assessment of behavioural reaction scored 0 to 3: nil, mild, moderate, severe.

Results. 4- to 6-year-old children reported higher pain ratings and had higher pain behaviour scores than older children, collapsed across intervention groups. Although the trend suggested that EMLA was more effective than the placebo or music treatment, no significant differences were noted using any of the three rating scales for 7- to 11-year-old and 12- to 16-year-old children. The youngest children receiving EMLA had lower pain scores than those in the other two treatment conditions.

Conclusions. 4- to 6-year-old children experienced the greatest benefit from the EMLA. Music distraction was not any more effective than placebo.

Nilsson, A., Engberg, G., Henneberg, S, Danielson, K. & De Verdier, C.-H. (1990). Inverse relationship between age-dependent erythrocyte activity of methaemoglobin reductase and prilocaine-induced methaemoglobinaemia during infancy. *British Journal of Anaesthesia*, 64, 72-76.

Objective. To measure methaemoglobin (MetHb) levels and plasma concentrations of lignocaine and prilocaine in infants < 3 months old after application of EMLA cream. The activity in erythrocytes of MetHb reductase in infants up to 12 months old after EMLA application was also measured.

Design. Case series.

Setting. Unspecified.

Participants. 10 infants, < 3 months old, scheduled for minor surgery or other procedures requiring venepuncture before anaesthesia. Analysis for activity of erythrocytes of MetHb reductase included data from infants aged 3-12 months.

Interventions. After venepuncture, EMLA 0.5 ml was applied to 4 different skin sites (not the limb requiring venepuncture), covered with occlusive dressings, and removed after 4 hours. Venous blood specimens were collected before EMLA application and 4, 8, and 12 hours after application.

Main Outcome Measures. After removal of EMLA, the paleness, redness, oedema or "other" reaction of the skin at the 4 sites were rated on a 4-point scale (none, slight, moderate, severe). Spectrophotometric analysis of MetHb was conducted. MetHb reductase was assessed using a standard method. Unmetabolized forms of lignocaine and

prilocaine were measured by gas chromatography, mass spectrometry, and gas chromatography with nitrogen sensitive detectors.

Results. There were no clinical signs of methaemoglobinemia or hypoxia during the study period. No paleness, oedema or other skin reactions to EMLA were noted; redness was observed in two infants. MetHb increased slightly after EMLA application; the increase was most pronounced in infants < 3 months. There was a negative correlation between MetHb reductase activity and maximal MetHb after EMLA application. In infants less than 3 months old, there was a relationship between age and MetHb reductase activity in erythrocytes. No relation was observed between maximum prilocaine concentration and maximum MetHb concentrations.

Conclusions. Although there was no clinically significant increase in MetHb, the higher values of MetHb after application of EMLA indicate a disturbance in the balance between formation and reduction of MetHb. EMLA should, therefore, be used with caution in infants younger than 3 months.

Nilsson, A., Boman, I., Wallin, B., & Rotstein, A. (1994). The EMLA patch - a new type of local anaesthetic application for dermal analgesia in children. *Anaesthesia*, 49, 70-72.

Objective. To compare the efficacy of the EMLA patch and EMLA cream for reducing pain from venepuncture in children. Skin adhesiveness of dressing and local reactions were also examined.

Design. Randomized controlled trial.

Setting. University hospital.

Participants. 60 children (27 females), 5-15 years of age, who required venous cannulation.

Interventions. Either 2.5 g of EMLA cream covered with an occlusive dressing, or a single unit dose EMLA patch was applied to the dorsum of the child's hand 60 to 180 minutes prior to venepuncture. Premedication for surgery (diazepam, pethidine, or oxazepam) was also given to 55 of the patients.

Main Outcome Measures. Ratings of pain intensity were made by the child immediately following venepuncture on a 100 mm Visual Analogue Scale (VAS; 0 = no pain, 100 = worst possible pain). The adhesiveness of the dressing or patch at the time of removal was assessed by the investigator (100%, 75-99%, 50-74%, <50%, 0%). Ratings of observed discomfort during the procedure (none, slight, severe) were made by the investigator.

Results. There was no significant difference observed between the efficacy of the EMLA cream and the EMLA

patch, based on child or investigator ratings. There was no difference in the adhesiveness or the amount of discomfort during removal of the occlusive dressing and the EMLA patch. There was no difference in local skin reactions to EMLA cream or the EMLA patch.

Conclusions. EMLA cream and the EMLA patch were equally effective in reducing pain from venepuncture, but the authors noted that the patch was easier to use.

Kapelushnik, J., Koren, G., Solh, H., Greenberg, M., & DeVeber, L. (1990). Evaluating the efficacy of EMLA in alleviating pain associated with lumbar puncture; comparison of open and double-blinded protocols in children, *Pain*, 42, 31-34.

Objective. To evaluate the efficacy of EMLA in reducing pain associated with lumbar puncture in children, and to compare different methodologies for evaluating blinded and non-blinded methodologies for evaluating EMLA's effectiveness.

Design. Open, crossover, randomized trial and double-blind, placebo-controlled trial (4-8 weeks elapsed between crossover).

Setting. 2 children's hospitals.

Participants. Open, crossover trial: 18 children with acute lymphoblastic leukemia (13 female; age range = 5-15 years; mean age = 9.2 years). Double-blind placebo-controlled trial: 10 children with cancer (2 female; mean age = 6.1 years).

Interventions. 45 to 60 minutes before the lumbar puncture, 2 mL of EMLA was applied and covered with an occlusive dressing.

Main Outcome Measures. For both designs, pain was rated on a 100 mm visual analogue scale (VAS; scored as 0 = no pain; 5 = most pain imaginable). In the open, crossover trial, children, parents, and nurses made ratings using the VAS. In the double-blind trial, only children made VAS ratings. Children and nurses made ratings using a scale (no reference) depicting faces increasing from smiling (no pain) to crying (maximal pain).

Results. Open crossover trial: VAS ratings made by children (1.66 vs. 2.55, $p < .0005$), parents (1.7 vs. 2.4, $p < .0005$), and nurses (1.6 vs. 2.4, $p < .0005$) in the EMLA treated group were significantly lower than with no treatment. Double-blind trial: with EMLA, children had lower VAS ratings (2.00 vs. 3.1, $p = .05$) and lower 'faces' ratings (2.9 vs. 3.8, $p = .07$) than with placebo, but in two cases pain ratings with EMLA were higher than that with placebo. Nurses' ratings on 'faces' were also lower for children receiving EMLA (2.7 vs. 3.7).

Conclusions. Although both studies showed that EMLA was successful in reducing pain, the results of the placebo-

controlled study suggested that the effect in the unblinded experiment may have been, in part, a placebo effect.

Commentary

There is little doubt that EMLA, an eutectic mixture of lidocaine and prilocaine, substantially reduces the pain from venepuncture. The abstracted studies represent only a fraction of the randomized trials demonstrating a clinically meaningful and statistically significant effect. In addition, there is emerging evidence of the effectiveness of EMLA in subcutaneous and intramuscular immunization (Taddio et al., 1994) lumbar punctures, access to implanted catheters (Halperin et al., 1989), and circumcision (Benini et al., 1993). EMLA has also been shown to be effective in dermatological surgery in the removal of molluscum contagiosum. EMLA must be placed on the skin and sealed one hour prior to the procedure and is cleaned from the skin before the procedure. EMLA is available in a cream and in a patch. They are equally effective but the patch is easier to apply (Nilsson et al., 1994). In some countries (e.g., Canada) it is available without a doctor's prescription, over-the-counter. Because of concerns with methaemo-globinaemia, EMLA is not recommended for children younger than 6 months old in Canada (in some countries, the age limit is lower) or with children who are taking sulfonamides (Nilsson et al., 1990). Additional data are needed on the safety of EMLA in the newborn. Buckley and Benfield (1993) provided an excellent review of the pharmacology and effect of EMLA. The use of EMLA is somewhat restricted by the one hour delay in its effectiveness and by its cost.

Alternatives to EMLA may emerge (e.g., an amethocaine patch; Doyle et al., 1993). TAC (a mixture of tetracaine, adrenaline and cocaine) is used for suturing open wounds but is not effective on unbroken skin. Because, in its present formulations, EMLA is not sterile, it is not used on open wounds.

Although most studies have been done on healthy children, the greatest benefit may be with children who have chronic illness and are subjected to repeated procedures. These children do not habituate to pain and may sensitize to pain with repeated procedures. EMLA has been an important addition to the pain management of procedures in children.

Patrick J. McGrath, Ph.D.
Psychology Department, Dalhousie University
Pain Service, Izaak Walton Killam Grace Health Centre
Halifax, Canada

References

- Buckley, M. M., & Benfield, P. (1993). Eutectic lidocaine/prilocaine cream: A review of the topical anaesthetic/analgesic efficacy of a Eutectic Mixture of Local Anaesthetics (EMLA). *Drugs*, 46, 126-151.
- Doyle, E., Freeman, J., Im, N. T., & Morton, N. S. (1993). An evaluation of a new self-adhesive patch preparation of amethocaine for topical anaesthesia prior to venous cannulation in children. *Anaesthesia*, 48, 1050-1052.

Patient-Controlled Analgesia for Children

Doyle, E., Mottart, K.J., Marshall, C., & Morton, N.S. (1994). Comparison of different bolus doses of morphine for patient-controlled analgesia in children, *British Journal of Anaesthesia*, 72, 160-163.

Objective. To compare the efficacy, morphine consumption, and side effects of a 10 $\mu\text{g}/\text{kg}$ and 20 $\mu\text{g}/\text{kg}$ PCA both with a background infusion of 4 $\mu\text{g}/\text{kg}/\text{h}$.

Design. Double blind, randomized controlled trial.

Setting. Children's hospital.

Patients. 40 children aged 6 to 14 years having appendectomy.

Interventions. Children were randomly assigned to receive either 10 $\mu\text{g}/\text{kg}$ morphine PCA or 20 $\mu\text{g}/\text{kg}$ PCA, both with a background infusion of 4 $\mu\text{g}/\text{kg}/\text{h}$. Both had a lockout period of 5 minutes and a background infusion of 4 $\mu\text{g}/\text{kg}/\text{h}$.

Main Outcome Measures. Recordings of SpO_2 , ventilation frequency, number of demands made and amount of morphine consumed, as well as observers' ratings on a 4-point scale of pain (0 = no pain; 3 = very sore) for pain at rest and with movement (breath and cough), nausea (0 = none; 3 = vomiting > once in past hour), and sedation (0 = eyes open spontaneously; 3 = unrousable).

Results. Children who received 20 $\mu\text{g}/\text{kg}$ consumed more morphine than children who received 10 $\mu\text{g}/\text{kg}$, who subsequently reported more pain during movement. There were no significant differences in pain at rest, nausea, amount of sleep, or unsuccessful demands. Children who received 10 $\mu\text{g}/\text{kg}$ had more SpO_2 , recordings less than 94% than the other children.

Conclusions. Children who received 10 $\mu\text{g}/\text{kg}$ of morphine PCA had higher pain scores and more episodes of hypoxaemia, than those who received 20 $\mu\text{g}/\text{kg}$ PCA. Differences in pain were found during movement, but not at rest.

Berde, C.B., Lehn, B.M., Yee, J.D., Sethna, N.F., & Russo, D. (1991). Patient-controlled analgesia in children and adolescents: A randomized, prospective comparison with intramuscular administration of morphine for postoperative analgesia, *Journal of Pediatrics*, 118, 460-466.

Objective. To compare effectiveness, safety, and side effects of morphine PCA, morphine PCA with background infusion, and intramuscular (IM) morphine.

Design. Randomized controlled trial.

Setting. Children's hospital.

Participants. 119 children scheduled for elective orthopaedic surgery were invited to participate. The surgeries were expected to cause significant postoperative pain and require a hospital stay of at least 2 days. 99 parents and children (aged 7-19 years) agreed, 17 were unable to complete study because of medical or other reasons.

Interventions. Children were randomly assigned to receive IM morphine (0.1 - 0.15 mg/kg every 3 hours, with an increase to 0.18 mg/kg if necessary), 0.025 mg/kg/dose morphine PCA, or 0.018 mg/kg/dose morphine PCA with a continuous background infusion of 0.015 mg/kg/h. Both PCA conditions had a lockout period of 10 minutes and a maximum dose of 0.24 mg/kg over 4 hours.

Main Outcome Measures. Both nurses and children were asked to make ratings of their pain, sedation, nausea, anxiety, and satisfaction every 2 hours (while awake) using a 10 cm Visual Analogue Scale, for the 48 hours following their first dose of morphine. Nurses also recorded hourly whether the child was awake and the respiratory rate, and recorded every 4 hours pulse and blood pressure.

Results. Children who received PCA with infusion and PCA alone had lower self-report and nurses' ratings of pain than children who received IM morphine. Children who received either of the PCA protocols had lower sedation scores than children who received IM morphine. No group differences were observed in total morphine consumption, nausea, or urinary retention. Children who received PCA with an additional background infusion had higher ratings of satisfaction than children in the other two groups, but satisfaction ratings for all groups were high (> 7.7/10).

Conclusions. Overall, morphine PCA appears to be a more effective method of post-operative analgesia than IM injection of morphine. The authors noted that PCA with a continuous background infusion improved pain control without increasing total consumption or risk for side effects.

Skues, M.A., Watson, D.M., O'Meara, M., Goddard, J.M. (1993). Patient-controlled analgesia in children. A

comparison of two infusion techniques. *Paediatric Anaesthesia*, 3, 223-228.

Objective. To compare PCA to PCA with a concurrent background infusion in children for post-operative pain, and to examine additional benefits of the background infusion.

Design. Randomized controlled trial.

Setting. Children's hospital.

Participants. 40 children undergoing abdominal surgery and 40 children undergoing orthopaedic surgery aged 6 to 16 years. Participants were randomly assigned to receive either PCA (Group 1) or PCA with background infusion (Group 2). Four children were subsequently excluded from the study due to ineffective analgesia.

Interventions. Children received either self-administered doses of 20 μ g/kg morphine (Group 1) or 10 μ g/kg morphine with a background infusion of 20 μ g/kg/h of morphine (Group 2). There was a lock-out interval of 6 minutes and the maximum permitted dose was 120 μ g/kg/h.

Main Outcome Measures. Morphine consumption, nurses' ratings of pain on a 0-3 scale (0 = no pain; 3 = severe pain) and ratings of sedation on a 0-3 scale (0 = awake and orientated; 3 = unrousable or asleep).

Results. Orthopaedic surgery: Children in Group 2 used significantly more morphine compared with children in Group 1. No difference was observed in pain scores. Sedation scores were similar until second evening after surgery when more patients in Group 2 were asleep. **Abdominal surgery:** No difference was observed in morphine consumption or overall pain scores between groups. Pain scores were significantly lower on the second day of PCA use in Group 1, and more so in Group 2.

Conclusions. Children remained pain free 80% of the time, as estimated by nurses' ratings. Results suggested that either PCA regimen provided safe and effective pain management with little risk of side effects. The authors noted that the concurrent infusion may have provided additional benefits, as children who received the concurrent infusion had an increased nocturnal and decreased daytime consumption, sleep was facilitated, and no adverse effects were observed.

Doyle, E., Harper, I. and Morton, N.S. (1993). Patient-controlled analgesia with low dose background infusions after lower abdominal surgery in children. *British Journal of Anaesthesia*, 71, 818-822.

Objective. To compare morphine PCA to morphine PCA combined with two different low dose background infusions on postoperative analgesia, sleep, morphine consumption,

sedation, nausea, vomiting, respiratory depression, and oxygen saturation.

Design. Randomized controlled trial.

Setting. Children's hospital.

Participants. 45 children (25 males; aged 6-12 years) undergoing appendectomy who did not receive preoperative analgesia.

Interventions. Children were randomly assigned to one of three PCA conditions: 20 $\mu\text{g}/\text{kg}$ of morphine PCA without background infusion; 20 $\mu\text{g}/\text{kg}$ of morphine PCA with a continuous background infusion of 4 $\mu\text{g}/\text{kg}/\text{h}$; 20 $\mu\text{g}/\text{kg}$ of morphine PCA with a continuous background infusion of 10 $\mu\text{g}/\text{kg}/\text{h}$. All conditions had a lockout period of 5 minutes.

Main Outcome Measures. Hourly recordings of SpO₂, ventilatory frequency, sedation, number of PCA demands, and volume of solution infused were made. On a 4-point scale, ratings of nausea (0 = none; 3 = vomited > once in past hour) sedation (0 = eyes open spontaneously; 3 = unrousable) were made hourly. Children rated their pain hourly on a self-report, 4-point scale (0 = no pain; 3 = very sore).

Results. Children who received the 10 $\mu\text{g}/\text{kg}/\text{h}$ background infusion consumed significantly more morphine and had significantly more SpO₂ recordings < 94% than the other two groups. They also had more episodes of nausea and vomiting than children in the other groups. Children who did not receive a background infusion had more SpO₂ recordings < 94% than children who received the 4 $\mu\text{g}/\text{kg}/\text{h}$ background infusion. No group difference was observed in hourly pain scores. Children who received a background infusion slept more at night compared to children with PCA alone.

Conclusions. A 4 $\mu\text{g}/\text{kg}/\text{h}$ background infusion of morphine in a PCA regimen for children for postoperative pain was associated with better sleep, less respiratory depression, and fewer other side effects than PCA alone, or a background infusion of 10 $\mu\text{g}/\text{kg}/\text{h}$. The authors suggested that the improved analgesia associated with the addition of a background infusion likely assisted ventilation and subsequently produced less hypoxaemia.

Tyler, D.C., Woodham, M., Stocks, J., Leary, A., Lloyd-Thomas, A. (1995). Oxygen saturation in children in the postoperative period. *Anesthesia and Analgesia*, 80, 14-19.

Objective. To perform paired preoperative and post-operative overnight measurements of oxygen saturation (SpO₂) in children receiving opioid analgesia.

Design. Case series.

Setting. Children's hospital.

Participants. A convenience sample from the operative lists of 32 children (< 13 years old) undergoing surgery associated

with significant postoperative pain and an additional 50 children (< 13 years old) on whom preoperative data was unavailable.

Main Outcome Measures. Mean SpO₂ and time below 95%, 90%, 85% and 80%.

Results. 13 participants were excluded from the first group because of confounds and/or missing data. For the remaining 19, the mean (SD) pre-operative oxygen saturation was 96.6% (-/+ 1.2%). The average change was .88% -/+. The 95% confidence interval of the paired differences was .13% to 1.6%. There were no significant differences in the percent of monitored time that children spent with an oxygen saturation less than 95%, 90%, 85% or 80%. The children monitored only in the postoperative period had a mean (SD) saturation of 97.8% (-/+ 1.9%).

Conclusions. In this study, children did not have multiple significant periods of oxygen desaturation during the postoperative period. Further research is necessary to determine the factors underlying postoperative oxygen desaturation in children.

Commentary

The article by Doyle et al. (1994) was the first to examine the effects of different bolus dose sizes of morphine and compared 10 $\mu\text{g}/\text{kg}$ with 20 $\mu\text{g}/\text{kg}$ in the presence of a low-dose 4 $\mu\text{g}/\text{kg}$ background infusion. The common use of 20 $\mu\text{g}/\text{kg}$ bolus was supported by reduced pain on movement and no increase in side effects, and fewer episodes of reduced SaO₂ were recorded. Doyle et al., also noted that patients will not necessarily titrate smaller boluses to achieve equivalent pain control. This finding makes the use of PCA opioid sparing as a measure of the efficacy of some other analgesic technique very questionable.

The articles by Berde et al. (1991), Skues et al. (1993), and Doyle et al. (1993) all examined the use of a background infusion in children. Perceived benefits of adding a background infusion include smoother analgesia, better sleep pattern, fewer episodes of severe pain, and that younger children do not have to rely solely on button presses for analgesia. Perceived disadvantages include that opioid requirements are higher, sedation, nausea, and vomiting are more common, safety may be compromised, and episodic reductions in oxygen saturation are more common. Some of these benefits and disadvantages are subjective and impossible to quantify. Others have been empirically evaluated.

For example, Berde et al. (1991) demonstrated an increased efficacy of PCA over intramuscular analgesics in

children. This study also showed that in children undergoing orthopaedic surgery, the addition of a 15 $\mu\text{g}/\text{kg}/\text{hr}$ background infusion reduced episodes of severe pain and did not affect morphine requirements or the incidence of side-effects.

Skues et al. (1993) studied 80 children undergoing either orthopaedic or abdominal surgery. They found that, following abdominal surgery, the addition of a 20 $\mu\text{g}/\text{kg}/\text{hr}$ background infusion to 20 $\mu\text{g}/\text{kg}/\text{hr}$ PCA improved sleep patterns without an increase in morphine consumption. Following orthopaedic surgery, children with the background infusion had higher morphine consumption but no difference in pain scores or side effects compared to children with PCA only.

Doyle et al. (1993) studied 45 children undergoing appendectomy with and without background infusions of 0, 4 and 10 $\mu\text{g}/\text{kg}/\text{hr}$ after Doyle, Robinson, and Morton (1993) demonstrated increased side effects with 20 $\mu\text{g}/\text{kg}/\text{hr}$ background infusion. With a smaller background infusion of 4 $\mu\text{g}/\text{kg}/\text{hr}$, they found improvement in sleep pattern and a reduction in the incidence of hypoxic episodes.

The findings of these studies demonstrate that methods of PCA prescribing should be tailored to suit the needs of individual children. Bolus dose sizes of 15 to 20 $\mu\text{g}/\text{kg}$ are used in most pediatric hospitals, and this is supported by Doyle et al. (1994). Lockout intervals have not been formally studied but a 5 minute lockout period has been used widely without any compromise in patient safety. The issue regarding the use of background infusion (BI) remains more complex because of differences in the ages of children, the types of surgery, which drugs are used, the different types of pain measured (rest pain vs. incident pain), and how large a background infusion is employed. Based on the studies above and on common clinical practice, I would suggest the following guidelines:

20 $\mu\text{g}/\text{kg}/\text{hr}$ BI: long-term PCA (e.g., oncology, burns), and younger children

10 $\mu\text{g}/\text{kg}/\text{hr}$ BI: major surgery (e.g., laparotomy, scoliosis surgery).

4 $\mu\text{g}/\text{kg}/\text{hr}$ BI: minor surgery (e.g., appendix, peripheral orthopaedics).

No BI: opioid sensitive patients, minor surgery, neurosurgery, or if PCA is supplemented with oral NSAIDs.

For surgery, the BI is usually discontinued after 24 to 48 hours and the patient continues on PCA boluses. If side effects are problematic, the first response should be to remove the background infusion.

Oxygenation and PCA in Children:

Research in the adult population has found a high incidence of desaturation episodes during the postoperative period with all patients receiving opioids. Studies in children have only recently come forth. Tyler et al., (1995) monitored

overnight paired preoperative and postoperative oxygen saturations in 19 children, and overnight postoperative saturations in 50 additional children undergoing surgery which required epidural, intravenous, or intramuscular opioids. There was no significant drop in oxygen saturation in this group. These data suggested that, in contrast to adults, children have fewer episodes of clinically significant oxygen desaturation in the postoperative period.

Morton (1993) described the use of a monitoring protocol incorporating pulse oximetry for children receiving PCA. In a study of 75 children, 84% of SpO₂ readings were in the range of 95-100%. Only 1% of SpO₂ recordings were < 90% and none were associated with a slow respiratory rate or sedation. Clinically, this suggests that there is no need for routine pulse oximetry, but it should be available for spot checks in wards where children have undergone major surgery. The need for continuous pulse oximetry is usually reserved for children who have undergone surgery which is expected to impair respiratory function.

Phil Gaukroger, FANZCA
Paediatric Anaesthetist
Women's and Children's Hospital
North Adelaide, South Australia

References

- Doyle, E., Robinson, D., & Morton, N. S. (1993). Comparison of patient-controlled analgesia with and without a background infusion after lower abdominal surgery in children. *British Journal of Anaesthesia*, 71, 670-673.
- Gaukroger, P. B., Chapman, M. J., & Davey, R. B. (1991). Pain control in paediatric burns - the use of patient-controlled analgesia (PCA). *Burns*, 17, 396-399.
- Morton, N. S. (1993). Development of a monitoring protocol for the safe use of opioids in children. *Paediatric Anaesthesia*, 3, 179-184.

Recent Articles

Varni, J.W., Rapoff, M.A., Waldron, S.A., Gragg, R.A., Bernstein, B.H., & Lindsley, C.B. (1996). Chronic pain and emotional distress in children and adolescents. *Developmental and Behavioral Pediatrics, 17*(3), 154-161.

Objective. To investigate the relation between emotional distress and chronic pain in children and adolescents.

Design. Survey.

Setting. Children's hospital (rheumatology division) and university medical centre (pediatrics department)

Participants. Of 190 children recruited, complete information was obtained for 160 children (49 male; age range = 5-16 years; all English-speaking and receiving medical treatment for rheumatic diseases).

Main Outcome Measures. VAS pain intensity ratings from Varni-Thompson Pediatric Pain Questionnaire; Children's Depression Inventory; State-Trait Anxiety Inventory for Children; Self-Perception Profile for Children; Child Behavior Checklist (both child-report and parent-report measures were used).

Results. Controlling for both demographic and medical variables, higher patient-perceived pain intensity was associated with greater emotional distress in both children and adolescents based on self-report and parent-report. Specifically, higher patient-perceived pain intensity was associated with more symptoms of depression and anxiety, lower self-esteem, and more externalizing and internalizing behaviours. Less consistent relations were observed between emotional distress in both children and adolescents and parent-perceived pain.

Conclusions. These findings are consistent with a large body of literature which has shown a significant relation between chronic pain and symptoms of emotional distress (e.g., depression, anxiety, anger) in adults. Numerous suggestions are offered regarding the relevance of these findings to the treatment and prevention of chronic pain in children and adolescents.

Scholer, S.J., Pituch, K., Orr, D.P., & Dittus, R.S. (1996). Clinical outcomes of children with acute abdominal pain. *Pediatrics, 98*(4), 680-685.

Objective. To examine the prevalence, associated symptoms, and clinical outcomes of children who present with acute

abdominal pain to an outpatient clinic.

Design. Historical cohort.

Setting. Pediatric clinic and emergency department of a teaching hospital.

Participants. 1141 children (598 females; 2-12 years old; mean age = 6.6 years; 54.8% African-American) who presented for a non-scheduled visit between January 1, 1993 and October 31, 1993 with a complaint of nontraumatic abdominal pain of less than 3 days duration. Because some children had multiple, non-scheduled visits for abdominal pain during the study period, only the first visit was considered.

Main Outcome Measures. Demographic variables, presenting signs and symptoms recorded by nurse and/or physician, hospital records, laboratory test results, radiograph test results, and telephone follow-up.

Results. The prevalence of acute abdominal pain was 5.1%. The six most common associated signs and symptoms were history of fever (64.0%), emesis (42.4%), decreased appetite (36.5%), cough (35.6%), headache (29.5%) and sore throat (27.0%). The six most prevalent final diagnoses were upper respiratory infection and/or otitis (18.6%), pharyngitis (16.6%), viral syndrome (16.0%), abdominal pain of uncertain etiology (15.6%), gastroenteritis (10.9%) and acute febrile illness (7.8%). Eighty-four children returned for re-evaluation within 10 days; the final diagnosis changed for 2% of all children.

Conclusions. Abdominal pain is a common symptom for many childhood illnesses and diseases. Although most children who presented with abdominal pain had relatively benign illnesses, follow-up identified 1% to 2% who were eventually diagnosed with a more serious underlying condition.

Lewis, D.W., Middlebrook, M.T., Mehallick, L., Manning Rauch, T., Deline, C., & Thomas, E. F. (1996). Pediatric headaches: What do the children want? *Headache, 36*, 224-230.

Objective. To better understand children's and adolescents' perception of headache and their fears and expectations about treatment.

Design. Survey.

Setting. Pediatric headache clinic.

Patients. 100 consecutive children (median age = 10.5 years; age range: 3-17 years old; 55 females) referred to the clinic from a military health care system. All had recurrent headaches for more than 3 months.

Main Outcome Measures. Modified McGill-Melzack Headache survey was completed by each participant (clinical staff member assisted pre-literate children). Prensny-Sommer

criteria were used for diagnosis of migraine. Children's drawings of "how they feel when they have a headache" were assessed for non-verbal pain perceptions.

Results. 93% of children were diagnosed with migraine, 2% with mixed tension-vascular, 2% tension/muscle contraction headache, and headaches in 3% were given classification "other". Tension/pressure (68%), bright light (51%), and loud noise (40%) were identified by children as precipitating or exacerbating the headache. Children rated the following "most important" about their medical visit: that they find the cause of pain (70%), that they obtain pain relief (68%), and that they obtain reassurance that the pain is not from a brain tumour (59%). 75 children drew pictures for analyses (40 of these drew symptoms). The drawings revealed depressive representations, helplessness, crying, frustration, anger, and depictions of death. Classification was done by a certified registered art therapist, but no information was provided on whether drawings were assessed using standardized or validated methods.

Conclusions. Children were able to report a number of things that precipitated or exacerbated their headache. Most reported that, during a medical visit for their headache, it was most important to find out the cause of the headache, obtain pain relief and gain reassurance that they did not have a serious disease.

Kazak, A.E., Penati, B., Boyer, B.A., Himelstein, B., Brophy, P., Waibel, M.K., Blackall, G.F., Daller, R., & Johnson, K. (1996). A randomized controlled prospective outcome study of a psychological and pharmacological intervention protocol for procedural distress in pediatric leukemia. *Journal of Pediatric Psychology, 21(5), 615-631.*

Objective. To determine the efficacy of a pharmacological and combined pharmacological and psychological intervention during painful procedures for leukemia treatment.

Design. Randomized controlled trial with additional standard treatment control.

Setting. Pediatric Oncology Clinic

Participants. 92 children under the age of 18 recently diagnosed with leukemia, and 70 matched controls receiving treatment for leukemia after a first remission, and their parents.

Interventions. Pharmacological only (PO) group: conscious sedation premedication, as per the Analgesia Protocols for Procedures in Oncology (APPO), prior to lumbar punctures and bone marrow aspirations. Combined intervention (CI) group: premedication and a parent-mediated psychological intervention individually suited to child's age and cognitive

level. Cross-section control (CC) group: standard treatment prior to the initiation of APPO.

Main Outcome Measures. Parent and child distress was rated by parents and staff during each procedure, and were averaged at 1, 2, and 6 months following initial diagnosis in PO and CI groups. Parents in all groups completed global measures of parent and child distress during procedures, the Parent Stress Index - Short Form, The Pediatric Oncology Quality of Life Scale.

Results. Children in the CI group were rated by mothers and nurses as less distressed than other children. Mothers reported that their children were less distressed over the first two months and more distressed over the 2nd to 6th month during and before procedures. Parents reported that their child's overall quality of life improved over time. Based on parents' and nurses' ratings, an inverse relation between age and distress during procedures was noted. Mothers and fathers of children in the PO and CI groups reported higher levels of distress than parents of children in the CC group, and parents in the combined intervention group reported lower distress than mothers in the other groups.

Conclusions. Both the pharmacologic and the combined interventions were associated with low to modest levels of parent and child distress. The authors concluded that parents and children learn to cope with painful and distressing events. This coping is enhanced by pharmacological and psychological interventions.

Johnston, C.C. & Stevens, B.J. (1996). Experience in a neonatal intensive care unit affects pain response. *Pediatrics, 98(5), 925-930.*

Objective. To examine differences in reactions to a heel stick procedure between infants 4 days old and 4 weeks old, when both groups are at 32 weeks post-conceptual age.

Design. Case control.

Setting. Neonatal intensive care units (NICU) of two university teaching hospitals.

Participants. 89 infants at 32 weeks post-conceptual age were included: 36 infants were born at a mean of 27.3 weeks gestational age, were examined at 4 weeks post-natal age, and had remained in the NICU during the post-natal period; 53 infants were born at a mean of 32.3 weeks gestational age and were examined 4 days following birth. All were free from major congenital abnormalities, none had had surgery or severe birth asphyxia. 11% of parents approached to participate refused.

Main Outcome Measures. Heart rate and minimum oxygen saturation were assessed during a 60 second baseline period prior to the procedure, for 60 seconds during the heel

warming period, for 15 seconds during the heel lance, and for 30 seconds during the heel squeeze. Facial responses (brow bulge, eye squeeze, nasolabial furrow) were coded using the Neonatal Facial Action Coding System.

Results. The two groups differed significantly in weight, and the severity of illness approached statistical significance. Earlier-born infants, assessed at 4 weeks post-natal age, had significantly higher heart rates and significantly lower oxygen saturation (typically below 90%) during all phases of the procedure, than did the group assessed at 4 days post-natal age. Overall, the infants assessed at 4 days post-natal age displayed significantly more facial actions during the procedure than did the earlier born infants. The total number of invasive procedures explained the most variance for the facial actions.

Conclusions. Results suggested that the earlier-born infants showed a depressed pattern of facial actions in response to pain than the newly born infants, and, consistent with previous literature, earlier-born infants showed a poorer physiological response to pain.

Book review

Kuttner, L. (1996). *A Child in Pain: How to Help, What to Do*. Vancouver: Hartley & Marks, Publishers, Inc., 272pp. ISBN 0-88179-128-8-PB

Although primarily intended for parents, this book is also relevant to health professionals who work with children. Dr. Kuttner's presentation of how children experience pain and how to best help them is thoughtful, thorough, and easily applicable in daily practice.

The first section deals with general aspects of pain as it relates to children of different ages. The approach to the general topic of pain is positive, setting the tone for the remainder of the book. Salient points include that: 1) pain has an important protective role in most instances; 2) it can be controlled, and most importantly; 3) children and parents can be the ones to take control of the pain, they can often prevent it, and if it does occur, they can develop the skills to deal with it. Reinforced throughout the book is the assumption that parents know their children best and that the child and parent are the major players on the team that deals with the pain. Myths about children and pain are dispelled.

The second section addresses assessment and measurement of pain in children, followed by non-pharmacological and pharmacological methods to alleviate pain. The style is detailed and prescriptive. Appropriate ages for each intervention, type of pain most likely to respond to the intervention, how long it will take to implement the intervention, and other important notes are presented, along with step-by-step details of the implementation. This presentation makes the possibility of implementation much more likely than general principles typically encountered in textbooks. Always there is the caveat of individual and circumstantial particulars that might influence the intervention. In the section on pharmacological management of pain, a general overview is first presented that includes what type of questions are important to ask the family pharmacist, routes of drugs, administration schedules of drugs, and different classes of drugs with their appropriate indications, actions, and cautionary notes.

The final section addresses specific problems ranging from common everyday pains or fears about pain that children may have, such as visits to the doctor or the dentist, to less common, but often painful and very frightening visits to the hospital emergency room or other units that include painful procedures. Differences in ages are recognized, with specific guidelines for each age group. Again, details are given to help parents help their children get through some situations. It is clear that Dr. Kuttner has had tremendous experience with children in hospital situations. While guidelines are given with the implication that, if followed, a hospital visit will be less painful, there is the recognition that there will be times when things will not go as well as planned. In the positive tone throughout the book, how a difficult experience can be changed into a learning experience that will prevent its recurrence is presented, so that children and parents will not feel that they have failed.

In summary, this book is highly relevant and applicable to anyone involved in the care of children.

C. Céleste Johnston, RN, D.Ed.
McGill School of Nursing
Montréal, Canada

Announcements

Meetings

April 25 - 26, 1997: *Children in Pain: Meeting the Challenge*, Hyatt Regency Hotel, Dearborn, Michigan. Co-sponsored by the Children's Hospital of Michigan, Wayne State University and the University of Michigan C.S. Mott Children's Hospital. This interdisciplinary conference will address important issues relevant to management of children's pain. Contact: Carol Williams, Tel. (313) 763-5283 or email: cwms@umich.edu.

June 29 - July 4, 1997: *International Symposium on Pediatric Pain*, Sponsored by the SIG on Pain in Childhood. Contact: Dr. Eeva-Liisa Maunuksela, Department of Ophthalmology, Helsinki University, Central Hospital, 00290 Helsinki, Finland.
Tel. 358-0-471-3101; Fax. 358-0-471-5008.

Other

The *Journal of Palliative Care*, 1996, 12(3), is a special issue titled "When Children Have to Die". The issue contains 12 articles on palliative care in children. Inquiries can be directed to the Centre for Bioethics, Clinical Research Institute of Montreal, 110 Pine Avenue West, Montreal, Quebec, Canada, H2W 1R7; Tel (514) 987-5621; Fax (514) 987-5695; email: marcote@ircm.umontreal.ca.

La lettre de PÉDIADOL, issue 3, was published in June, 1996. It is a 16-page, French-language newsletter on pediatric pain. Contents of this issue include Pain and Sucrose, EDIN scale to assess non-acute pain in neonates, and bibliographic references on pediatric pain control. A complimentary copy can be obtained from Dr. Daniel Annequin, Unite d'Analgesie Pédiatrique, Hopital d'enfants Armand Trousseau, 26, avenue du Dr. Arnold Netter, 75571 Paris Cedex 12, email: 100433.1534@compuserve.com.

The October 1996 issue of the *Journal of Pediatric Psychology* (Vol. 21, No. 5), contains a special section on pediatric pain. An additional special section on interventions in pediatric psychology contains two articles that are also relevant to those interested in pediatric pain.

A recent issue of *BMJ* (1996;313:795-799) contains a fascinating debate on whether fetuses feel pain - a must read for all those interested in the area.

Post-doctoral Fellow wanted. Any area of pediatric pain. Date can be negotiated. Competitive salary. Contact Patrick J. McGrath Ph.D. Dalhousie University, Halifax, NS, Canada, B3H 4J1; phone (902) 494-1580, fax (902) 494-6585, email: Patrick.McGrath@dal.ca.

Short announcements on pediatric pain will be published gratis.

If you would like to participate

Your participation in abstracting and writing commentaries for the Pediatric Pain Letter is welcomed. Please send submissions according to the specifications outlined in our Author's Kit. An Author's Kit can be obtained from Julie Goodman, Managing Editor, Pediatric Pain Letter, Psychology Department, Dalhousie University, Halifax, Nova Scotia, B3H 4J1; email jgoodman@is2.dal.ca; requests can be made in writing or by email. Abstracts and commentaries on any aspect of pain in infants, children, and/or adolescents are appropriate. We will attempt to use abstracts and commentaries but the editors reserve the right to edit or reject contributions.

Supported by an educational grant from



makers of



Contributors to this issue: Sonia Beattie, Sally Bird, Lynn Breau, Mary Ann Campbell, Beth Currie, Deborah Johnson, Lilli Ju, Trudi Walsh, Krista Wilkins.