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[Intervention Review]

Caudal epidural block versus other methods of postoperative pain relief for circumcision in boys

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ABSTRACT

Background

Techniques to minimize the postoperative discomfort of penile surgery, such as circumcision, include caudal block; penile block; systemic opioids and topical local anaesthetic cream, emulsion or gel.

Objectives

To compare the effects of caudal epidural analgesia with other forms of postoperative analgesia following circumcision in boys.

Search methods

We searched CENTRAL (*The Cochrane Library* 2008, Issue 1), MEDLINE (to April 2008) and EMBASE (to April 2008).

Selection criteria

Randomized and quasi-randomized trials of postoperative analgesia by caudal epidural block compared with non-caudal analgesia in boys, aged between 28 days and 16 years, having elective surgery for circumcision.

Data collection and analysis

Two review authors independently carried out assessment of study eligibility, data extraction and assessment of the risk of bias in included studies.

Main results

We included 10 trials involving 721 boys. No difference was seen between caudal and parenteral analgesia in the need for rescue or other analgesia (relative risk (RR) 0.41, 95% confidence interval (CI) 0.12 to 1.43; 4 trials, 235 boys; random-effects model) or on the incidence of nausea and vomiting (RR 0.61, 95% CI 0.36 to 1.05; 4 trials, 235 boys). No difference in the need for rescue or other analgesia was seen for caudal compared with dorsal nerve penile block (DNPB) (RR 1.25, 95% CI 0.64 to 2.44; 4 trials, 336 boys; random-effects model). No differences were seen between caudal block and DNPB in the incidence of nausea and vomiting (RR 1.88, 95% CI 0.70 to 5.04; 4 trials, 334 boys; random effects model) or individual complications except for motor block (RR 17.00, 95% CI 1.01 to 286.82; 1 trial, 100 boys) and motor or leg weakness (RR 10.67, 95% CI 1.32 to 86.09; 2 trials, 107 boys). These were significantly more common in the caudal block groups than with DNPB. No differences were seen between caudal and rectal or intravenous analgesia in the need for rescue analgesia or any other outcomes (2 trials, 162 boys).

Authors' conclusions

Differences in the need for rescue or other analgesia could not be detected between caudal, parenteral and penile block methods. In day-case surgery, penile block may be preferable to caudal block in children old enough to walk due to the possibility of temporary leg weakness after caudal block. Evidence from trials is limited by small numbers and poor methodology. There is a need for properly designed trials comparing caudal epidural block with other methods such as morphine, simple analgesics and topical local anaesthetic creams, emulsions or gels.

PLAIN LANGUAGE SUMMARY

In boys having circumcision the need for additional (rescue) analgesia is similar whether caudal or penile block is used

Postoperative pain following circumcision frequently results in crying, restlessness and agitation that may be associated with an increased incidence of bleeding. Therefore, pain needs to be anticipated and effectively controlled. Caudal epidural block is performed with the patient partly prone or on his side. It is one of the most common local anaesthetic techniques used in children. When compared with penile block, the need for rescue analgesia was similar. For boys old enough to walk, penile block may be preferable to caudal block since caudal block may cause temporary leg weakness. No difference in the need for rescue analgesia was seen when caudal block was compared with parenteral opioid (by injection). Other methods such as simple analgesics and topical local anaesthetics (creams and gels) have not been adequately evaluated and need to be compared with caudal block.

BACKGROUND

Circumcision is a commonly practised surgical procedure in boys. Rates of circumcision vary from country to country. Estimates range between 10 to 20% for Australia, 65% in the USA, 7 to 10% for boys in the UK (Morris 2006) and less than 2% in Scandinavia (RACP 2004). Although elective circumcision is in decline worldwide, 3.8% of English boys are circumcised for non-religious reasons by the time they reach their 15th birthday (Rickwood 2000). In the UK, a 20% fall in circumcisions was noted between 1997 and 2003 (Cathcart 2006). Postoperative pain following circumcision frequently results in crying, restlessness and agitation, which may be associated with an increased incidence of bleeding (Tree-Trakarn 1985). There is widespread acceptance, for moral, ethical, humanitarian and physiological reasons, that pain should be anticipated and effectively controlled (Morton 1999). The basic requirements for managing pain following paediatric circumcision are patient safety, reliability, rapid recovery, a low risk of adverse effects and ease of administration of a painless technique.

Caudal epidural block is one of the most common local anaesthetic techniques used in children (Murdoch 1995; Russell 1997), both to supplement general anaesthesia and provide postoperative analgesia. A caudal technique is usually performed with the child either semi-prone or on one side. A strict aseptic technique is used and a fine needle is passed through skin and the sacrococcygeal ligament, a ligamentous membrane in the midline of the lower back overlying the sacral hiatus (Peutrell 1996). This allows injection of local anaesthetic or other analgesic drugs into the sacral part of the epidural space where nerves that supply the penis are. Potential but rare complications associated with caudal analgesia include accidental intravenous (iv) or intramarrow injection, dural puncture, neuralgia and infection (Peutrell 1996). A relatively common complication associated with caudal analgesia is epidural haematoma. In addition, caudal block requires extra time and expense for its performance. Several other analgesic techniques including penile block, systemic narcotic analgesics and topical analgesia are being used (Russell 1997; Tree-Trakarn 1985).

Two main types of penile block are described. Dorsal nerve penile block (DNPB) is performed by injecting local anaesthetic through the skin just below the pubic bone at the base of the penis (Peutrell 1996); alternatively a subcutaneous ring of local anaesthetic can be injected around the base of the penis shaft (Murdoch 1995). Patients having a penile block do not require the special positioning of a caudal technique. However both techniques require the child to remain still, which is usually achieved by performing the block under general anaesthesia. DNPB is said to provide effective analgesia (Soliman 1978) but can be associated with localized haematoma formation, systemic toxicity from the local anaesthetic agent used and ischaemia of the penis if a solution containing adrenaline or excessive volumes of local anaesthetic are used (Peutrell 1996). Penile block is claimed to be free of the undesirable side effects associated with caudal analgesia, such as delayed mobilization, urinary retention, vomiting and lower extremity numbness (Soliman 1978). This block is also said to be simple, safe and effective (Lau 1984; Sfez 1990; Soliman 1978) and an early discharge may be possible (Tree-Trakarn 1985) due to rapid patient recovery (Lau 1984) following surgery.

Morphine may be effective in relieving postoperative circumcision pain but is associated with side effects such as drowsiness,

vomiting and respiratory depression (Tree-Trakarn 1985). The simple application of topical analgesia is said to be effective in postoperative pain relief following circumcision and is considered the most non-invasive of the various analgesic techniques (Tree-Trakarn 1985). Topical applications of local anaesthetic, such as lignocaine, can be repeated in the postoperative period and applied in the form of a spray, gel or ointment.

OBJECTIVES

To compare the effects of caudal epidural analgesia with other forms of postoperative analgesia following circumcision in boys.

METHODS

Criteria for considering studies for this review

Types of studies

We included published randomized controlled trials (RCTs) in which postoperative analgesia by means of a caudal epidural block was compared with a non-caudal method of analgesia.

Types of participants

We included boys aged between 28 days (post neonatal) and 16 years who were having elective surgery for circumcision.

Types of interventions

Perioperative administration of caudal epidural block compared with another method of analgesia such as systemic opioids, topical analgesia and subcutaneous ring block or dorsal nerve block of the penis.

Types of outcome measures

Number of patients

The number requiring rescue or other analgesia according to clear, predefined criteria (our preferred primary outcome measure). Requiring rescue analgesia was defined as the administration of analgesic medication for discomfort or disturbed behaviour; requiring other analgesia was defined as the administration of analgesic medication for discomfort or disturbed behaviour two hours or more after surgery.

The number with local or systemic complications; with nausea or vomiting requiring intervention; not passing urine prior to discharge from hospital; with delayed discharge from the hospital; requiring readmission to hospital.

Resource considerations

- Equipment costs
- Length of stay in hospital
- Procedural time

Search methods for identification of studies

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2008, Issue 1) using the search strategy given in [Appendix 1](#).

The Cochrane Anaesthesia Review Group searched:

- SilverPlatter MEDLINE (WebSPIRS) (to April 2008) using the search strategy given in [Appendix 2](#);
- SilverPlatter EMBASE (WebSPIRS) (to April 2008) using the search strategy given in [Appendix 3](#).

No language restrictions were applied.

Data collection and analysis

Two review authors independently assessed potential trials for eligibility. We noted the method of randomization, the placebo or control group, exclusion criteria, missing data, loss to follow up, blinding of outcome assessment as well as caudal technique and other analgesia interventions.

In previous versions of this review we specified that quasi-randomized trials would be included ([Cyna 2003](#)). For the 2008 update on, we excluded quasi-randomized trials.

We assessed the methodological quality of the included studies using the criteria described in the *Cochrane Handbook for Systematic Reviews of Interventions* ([Higgins 2006](#)). We assigned quality scores for allocation concealment to each trial: A = adequate, B = unclear, C = inadequate, D = not used. We eliminated studies rated as D.

1. We assessed studies for completeness of follow up:
 - a. less than 3% of participants excluded;
 - b. (3% to 9.9% of participants excluded;
 - c. 10% to 19.9% of participants excluded;
 - d. 20% or more excluded;
 - e. unclear.
2. Where appropriate, we assessed studies for blinding:
 - a. neither outcome assessor nor participant or parent knew, or were likely to guess, the allocated treatment;
 - b. either the outcome assessor or participant or parent knew, or were likely to guess, the allocation; or side effects of one or other treatment meant that it was likely that the allocation could be correctly identified in a significant proportion (greater than 20%) of participants;
 - c. no blinding, both investigator and participant knew or were likely to guess the allocated treatment;
 - d. unclear.

Due to the nature of the interventions, we included studies that were not blinded.

We excluded studies where the analgesic intervention within each group was not defined according to age or weight, where appropriate; or the anaesthetic technique was not controlled with respect to other analgesic medications.

We resolved any disagreements regarding inclusion of potentially eligible trials by discussion and, if needed, a third person would have acted as arbiter. We used Review Manager software ([RevMan 5.0](#)) for calculation of the treatment effects. We used relative risks (RR) with 95% confidence intervals (CI) for dichotomous outcomes and mean differences with 95% confidence intervals for continuous data.

We assessed statistical heterogeneity with the I^2 statistic. When I^2 was greater than 40%, we calculated results using both random-effects and fixed-effect models.

RESULTS

Description of studies

We included 10 RCTs and excluded four studies.

Participants

Most RCTs (seven out of 10) involved outpatients ([Concha 1994](#); [Lunn 1979](#); [Mak 2001](#); [May 1982](#); [Vater 1985](#); [Weksler 2005](#); [White 1983](#)); two were studies of inpatients ([Bramwell 1982](#); [Martin 1982](#)) and one study ([Gauntlett 2003](#)) did not report if the boys were day cases or stayed overnight.

In [Bramwell 1982](#) patients underwent orchidopexy, hernia repair or circumcision. However, the results were analysed separately enabling us to include data from those boys having circumcision in this review.

Interventions

Four RCTs compared caudal injection with parenteral analgesia ([Bramwell 1982](#); [Lunn 1979](#); [Martin 1982](#); [May 1982](#)). [Martin 1982](#) compared three groups, two with caudal injection and the third with parenteral opioid. We have analysed the two caudal groups together. Five RCTs compared caudal injection with dorsal nerve penile block ([Gauntlett 2003](#); [Mak 2001](#); [Vater 1985](#); [Weksler 2005](#); [White 1983](#)). Two RCTs compared caudal injection with intravenous fentanyl and rectally administered analgesic (acetaminophen in [Concha 1994](#) and the non-steroidal anti-inflammatory drug (NSAID) diclofenac in [Mak 2001](#)).

No study compared caudal with topical analgesia, such as EMLA (a eutectic, or emulsified, mixture of local anaesthetics) or other systemically administered analgesics such as NSAIDs or acetaminophen (paracetamol).

Outcomes

Need for rescue analgesia

This was reported either as failed blocks ([Gauntlett 2003](#); [Mak 2001](#)) or need for additional analgesia ([Bramwell 1982](#); [Lunn 1979](#); [Vater 1985](#); [Weksler 2005](#)) assessed in different ways in the early postoperative period. [Bramwell 1982](#) used dihydrocodeine (1 mg/kg) in the first two hours; [Lunn 1979](#) used a supplemental dose of morphine in the recovery room; [Vater 1985](#) used intramuscular morphine sulphate within one hour of surgery and [Weksler 2005](#) used paracetamol in the recovery room. Despite the different methods, all instances entered as rescue analgesia in this review occurred within the first two hours after the procedure. In [Mak 2001](#), some boys received analgesia within two hours of surgery but this was specifically stated as not being in the recovery room and so was not entered as rescue analgesia in the review. Some administration of analgesia in [Martin 1982](#) and [May 1982](#) may have been rescue analgesia but was classified here as other analgesia as not enough detail was reported to be certain that it was rescue analgesia. In [White 1983](#), analgesia was specified as for rescue but the results for this outcome were not presented in a form that could be used in our review. Further details are given in the [Characteristics of included studies](#) table.

Risk of bias in included studies

Randomization and concealment of allocation

None of the studies specified details of their randomization and allocation concealment processes, except for [Mak 2001](#) ("drawing cards") and [Weksler 2005](#) ("lottery of closed envelopes"). All studies were rated B (unclear) for allocation concealment.

Blinding of outcome assessments

In [Vater 1985](#) and [May 1982](#) both the outcome assessors and the boys and parents were blinded and in [Gauntlett 2003](#) both the parents and nurses were blinded. [Lunn 1979](#) stated that staff in recovery were unaware of the analgesic technique and in [Mak 2001](#) nurses but not the patients were blinded. In both [White 1983](#) and [Concha 1994](#) an anaesthetist assessed the need for analgesia postoperatively and was apparently blinded to the technique, however it is unclear as to whether the patients (or parents) were aware of the type of analgesia used. In [Weksler 2005](#) some outcome assessments, such as measurement of pain, were blinded. [Martin 1982](#) and [Bramwell 1982](#) did not mention blinding.

Losses to follow up

Most studies did not report any losses to follow up, although four boys with failed caudal blocks in [Bramwell 1982](#) were excluded (not reported if all four were undergoing circumcision). In [Martin 1982](#) there were two failures in the caudal block with bupivacaine only group and in [Mak 2001](#) two boys had caudal blocks abandoned; these two boys were then excluded from the study. No study provided an intention-to-treat analysis in which the failed caudal blocks were included; such analyses would be expected to show a decrease in effectiveness in the caudal block groups. In [Lunn 1979](#) about half the results for vomiting were missing and so these incomplete data were not entered in the meta-analysis graphs.

Effects of interventions

We have included 10 trials involving a total of 721 boys in the 2008 version of the review. Some trials made more than one comparison.

Caudal analgesia versus parenteral analgesia

Four trials ([Bramwell 1982](#); [Lunn 1979](#); [Martin 1982](#); [May 1982](#)) provided data for this comparison. (See [Analysis 1.1](#); [Analysis 1.2](#))

There was not a significant difference detected between caudal and parenteral analgesia in the need for rescue or other analgesia in the early postoperative period (RR 0.41, 95% CI 0.12 to 1.43; 4 trials, 235 boys; random-effects model). No difference was seen between caudal block and parenteral analgesia for rescue or other analgesia, separately; or for incidence of nausea and vomiting (RR 0.61, 95% CI 0.36 to 1.05; 4 trials, 235 boys).

Caudal analgesia versus dorsal nerve penile block (DNPB)

Five trials ([Gauntlett 2003](#); [Mak 2001](#); [Vater 1985](#); [Weksler 2005](#); [White 1983](#)) contributed data for this comparison. (See [Analysis 2.1](#); [Analysis 2.2](#); [Analysis 2.3](#); [Analysis 2.4](#); [Analysis 2.5](#))

No difference in the need for rescue or other analgesia was seen for caudal analgesia compared with DNPB (RR 1.25, 95% CI 0.64 to 2.44; 4 trials, 336 boys). Nor was a difference seen for need for rescue or other analgesia, separately (four and two trials respectively). This was also the case for nausea and vomiting (RR 1.88, 95% CI 0.70 to 5.04; 4 trials, 334 boys; random-effects model). No differences

were seen in individual complications such as bruising of the skin or at the needle site (RR 0.34, 95% CI 0.07 to 1.82; 3 trials, 274 boys) except for motor block where the caudal group had eight blocks and the DNPB group had none (RR 17.00, 95% CI 1.01 to 286.82; 1 trial, 100 boys) ([Weksler 2005](#)) and motor or leg weakness (RR 10.67, 95% CI 1.32 to 86.09; 2 trials, 107 boys) ([Gauntlett 2003](#); [White 1983](#)). [Weksler 2005](#) reported no significant difference in pain scores between caudal analgesia and DNPB (mean difference (MD) 0.50 points (out of 5), 95% CI -0.17 to 1.17; 1 trial, 100 boys).

[Gauntlett 2003](#) did not find any differences between caudal and DNPB for eating, sleep or behavioural disturbances.

Parents seemed equally satisfied with both methods (MD -0.10, 95% CI -0.58 to 0.38; 1 trial, 100 boys) ([Weksler 2005](#)).

In [Weksler 2005](#), both time to discharge home and procedural time were shorter with DNPB (MD 37 min, 95% CI 18.97 to 55.03; MD 1.90 min, 95% CI 1.33 to 2.47 respectively). [Mak 2001](#) did not find a significant difference between caudal and DNPB for length of recovery room stay (124 boys).

Caudal analgesia versus rectal or intravenous analgesia

Two trials ([Concha 1994](#); [Mak 2001](#)) compared caudal and rectal or intravenous analgesia. ([Analysis 3.1](#); [Analysis 3.2](#); [Analysis 3.3](#); [Analysis 3.4](#))

No differences were seen for any of the outcomes:

- need for any analgesia (rescue or other) (RR 0.81, 95% CI 0.51 to 1.27; 2 trials, 164 boys);
- need for rescue or other analgesia, separately (one and two trials respectively);
- nausea or vomiting (RR 0.88, 95% CI 0.14 to 5.53; 2 trials, 164 boys).

[Mak 2001](#) reported one instance of bleeding in each of the groups and one case of bruising of skin in the caudal group.

[Mak 2001](#) did not find a significant difference between caudal and rectal or intravenous analgesia for length of recovery room stay (124 boys).

DISCUSSION

Available evidence from trials is limited by small numbers and poor methodology. Many of these studies were performed more than 10 years ago, which may no longer reflect current practice. It is surprising that so few studies compare caudal with other methods of analgesia in this setting given the popularity of caudal block and the frequency of circumcision in boys. Indeed, many of the commonly available analgesic techniques, such as NSAIDs, paracetamol and different intravenous opioids, tramadol or topical local anaesthetic mixtures, have not been studied at all. Some trials have, however, compared DPNB with EMLA or other topical anaesthetics. While DPNB appears to be more effective than EMLA in neonates ([Brady-Fryer 2004](#)), this is not yet clear for older boys ([Hmamouchi 2001](#)).

Caudal and penile block appear to provide similarly effective analgesia. In view of the increased incidence of motor block it may be preferable to reserve caudal analgesia for younger children who

are not yet ambulatory. Penile block also may result in shorter procedural times and quicker discharge home.

The potential adverse effects of opioids, such as drowsiness, respiratory depression and nausea, have not been examined in relation to caudal analgesia apart from in one trial comparing dihydrocodeine with caudal analgesia ([Bramwell 1982](#)). Only the [Vater 1985](#) study fully reports our preferred primary outcome of patients requiring analgesia according to clear, predefined criteria. No considered study reports the other preferred outcomes stated in our original protocol, such as the incidence of nausea and vomiting requiring intervention, delayed discharge from hospital and any readmissions to hospital. There is recent evidence from controlled studies and also parent surveys following paediatric penile surgery that apparently satisfactory analgesia prior to discharge from the day-stay ward may not reflect adequate postoperative comfort at home ([Wolfe 1999](#)). Rare serious complications such as meningitis, penile necrosis ([Burke 2000](#); [Kaplanian 2007](#)) and total spinal block have not been identified in our review, probably due to the small numbers of patients studied.

AUTHORS' CONCLUSIONS

Implications for practice

Available evidence suggests that penile block and caudal analgesia both provide effective postoperative analgesia. The increased incidence of motor block associated with caudal analgesia suggests this technique should be reserved for younger children who are not yet ambulatory when having day-case circumcision. No firm conclusions can be made regarding the efficacy of caudal analgesia when compared with other methods of pain relief following circumcision in boys due to the small number of patients studied and poor methodology.

Implications for research

There is a need to perform properly designed trials to study the relative effects of caudal epidural block with other methods such

as systemic analgesia (for example with fentanyl or morphine), paracetamol, topical analgesia such as with lignocaine gel or EMLA or local anaesthetic drops. The outcomes of future studies should include the need for analgesia at home. Other systematic reviews could investigate:

- the relative efficacy of other non-caudal interventions for circumcision, for example penile block compared with other analgesic techniques;
- the relative efficacy of different caudal medications for circumcision, for example addition of morphine or clonidine, or both.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Bramwell 1982

Methods	Randomization and allocation concealment: Random numbers after induction of GA. Blinding: Not reported. Losses to follow up: None (although 4 boys with failed block were excluded - see Notes below).
Participants	90 inpatients aged 1-12 years having elective circumcision. Exclusions: caudal contra-indicated e.g. spina bifida, local sepsis. Setting: UK
Interventions	CAUDAL versus PARENTERAL Caudal (n = 46) 0.25% bupivacaine 0.5 ml/kg up to 40 ml (0.1875% used for volumes over 40 ml). Parenteral analgesia (n = 45): Dihydrocodeine 1 mg/kg IM after induction of anaesthesia and prior to surgery.

Caudal epidural block versus other methods of postoperative pain relief for circumcision in boys (Review)

Bramwell 1982 (Continued)

Outcomes	<p>Pain: Two 8-cm linear analogue scales were marked by a nurse every 5 minutes for 30 minutes and then every 15 minutes for the next 90 minutes, indicating the patient's level of pain from none to severe and level of consciousness (unrousable to alert), respectively.</p> <p>Rescue analgesia (dihydrocodeine 1mg/kg) was administered in the first 2 hours after surgery as needed at the nurses' discretion.</p> <p>Other outcomes: Vomiting, drinking, administration of analgesics and weakness.</p>
Notes	<p>In 4 cases, the caudal block failed (1 failure to locate the space, 1 suspected dural puncture and 2 bloody taps). These patients were excluded from the trial but the paper did not report which type of surgery was being performed and so we could not do an intention-to-treat analysis.</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Concha 1994

Methods	<p>Randomization and allocation concealment: methods not reported</p> <p>Blinding: Outcomes measured by an anaesthetist blind to the treatment group</p> <p>Losses to follow up: none reported</p>
Participants	<p>40 boys, mean age 4.7 years in caudal group and 5.6 years in fentanyl/rectal acetaminophen group, undergoing day surgery for circumcision.</p> <p>Setting: Chile</p>
Interventions	<p>CAUDAL versus RECTAL/IV</p> <p>Caudal: 0.25% bupivacaine 0.5 ml/kg (n = 20).</p> <p>Rectal/IV: Fentanyl 2 ug/kg IV after induction, and rectal acetaminophen 15 mg/kg (n = 20), repeated during 6 postoperative hours.</p> <p>All children received the same general anaesthetic.</p>
Outcomes	<p>Episodes of nausea and vomiting,</p> <p>passing of urine,</p> <p>quality of pain relief on a visual analogue scale, all measured by anaesthetist.</p> <p>Extra dose of acetaminophen given at anaesthetist's discretion.</p>

Notes

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Gauntlett 2003

Methods	<p>Randomization and allocation concealment: "randomly allocated".</p> <p>Blinding: Parents and ward nurses were blinded to which of the blocks the boys received by small spot dressings applied below the symphysis pubis and over the sacrococcygeal membrane to conceal the injection site; nurses on the paediatric day-care ward were instructed not to discuss any details of the</p>
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Caudal epidural block versus other methods of postoperative pain relief for circumcision in boys (Review)

Gauntlett 2003 (Continued)

two kinds of block with parents. 24 hours after discharge from hospital, parents were telephoned by a member of the anaesthetic team who was unaware of which block the child had received.
Losses to follow up: Not reported.

Participants	60 boys aged 1 to 10 years undergoing elective circumcision. Exclusions: contraindications to either type of block or parental inability to assess pain scores.
Interventions	CAUDAL versus DNBP Caudal (n = 30) 0.5 ml/kg bupivacaine 0.15% with ketamine 0.5 mg/kg; DNBP (n = 30); bupivacaine 0.5%, 3-5 ml according to age. Children were not premedicated other than with EMLA cream applied to the back of their hands. GA: IV propofol or inhalation of sevoflurane in nitrous oxide and oxygen as clinically appropriate. Anaesthetic maintenance was with nitrous oxide, oxygen and sevoflurane. All local anaesthetic procedures were performed by one experienced paediatric anaesthetist.
Outcomes	Rescue analgesia (as time to paracetamol - could not be used in meta-analysis, number of failed blocks used to measure this) Failed blocks Motor weakness (scale of 0-4) Nausea and vomiting (including severe PONV) Eating disturbance Sleep disturbance Behavioural disturbance Urinary retention
Notes	Block failure was defined as a persistent rise in heart rate, blood pressure or ventilation rate after incision which did not settle within 20 minutes of block administration, or if the child complained of pain immediately on emerging from anaesthesia. Alternative analgesia (including IV morphine if necessary) was given and the child was excluded from further analysis in the study.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Lunn 1979

Methods	Randomization and allocation concealment: random numbers after induction of GA, no further details reported. Blinding: Staff in recovery unaware of analgesia technique. Losses to follow up: No participants lost to follow up but information on vomiting incomplete (25/40 only).
Participants	40 boys aged 2-12 years selected for day-case circumcision for surgical reasons. Exclusion criteria: unfused sacral vertebrae. Setting: UK
Interventions	CAUDAL versus PARENTERAL Caudal (n = 20): 0.5% bupivacaine, 1.5 mg/kg. Patient semi-prone - no other technique details described. Parenteral analgesia (n = 20): IM morphine 0.15 mg/kg administered left deltoid as surgery started.
Outcomes	10-cm linear analogue scale labelled asleep at one end and restless at the other were marked by independent experienced staff nurse every 5 minutes for 30 minutes.

Caudal epidural block versus other methods of postoperative pain relief for circumcision in boys (Review)

10

Lunn 1979 (Continued)

Need for rescue analgesia (in recovery room)
Incidence of vomiting (in recovery room)
Incidence of later vomiting - partial results only (not able to be used)
Duration of stay in day unit
Time to standing unaided
Complications assessed by community nurse in first 24 hours and at Surgical Outpatients at one week.

Notes Anaesthetic technique: Same anaesthetist, thiopentone/atropine induction. Maintenance nitrous oxide/halothane/50% oxygen.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Mak 2001

Methods Randomization and allocation concealment: "drawing cards".
Blinding: Nursing staff were unaware of the type of analgesia given: parents were not blinded as the sacral area was left uncovered.
Losses to follow up: 2 boys had caudal blocks abandoned and these 2 boys were then excluded from the study.

Participants 187 (185) boys aged between 1 and 12 years, admitted for elective day-surgery circumcision.
Setting: Hong Kong

Interventions CAUDAL versus DNPB versus RECTAL/IV
Caudal (n = 61 (63)): 0.25% bupivacaine 0.5 ml/kg, maximum 20 ml - following induction, caudal blocks were given aseptically to the boys lying in a left lateral position.
DNPB (n = 63): 0.5% bupivacaine, < 15 kg - 2ml, 15-24 kg - 2.5 ml, 25-30 kg - 3 ml, 31-40 kg - 3.5 ml, > 40 kg - 4 ml; via intrapubic approach as described by Yeoman.
RD/IVFENT (n = 61): Rectal diclofenac (1 mg/kg) and intravenous fentanyl 0.5 g/kg.

Anaesthesia was induced by inhalation of sevoflurane and oxygen or intravenous propofol; maintained with nitrous oxide in oxygen and isoflurane.

Outcomes Rescue analgesia (failed block)
Other analgesia (no analgesia was given in the recovery ward, nurses gave oral paracetamol in day surgery ward if the boys complained of moderate or severe pain, or cried even in their parents' presence, or thrashed in beds, or were refrained from movement)
Duration of analgesia
Bleeding
Haematoma/bruising of needle site
Vomiting
Hospital stay

Notes

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Caudal epidural block versus other methods of postoperative pain relief for circumcision in boys (Review)

Martin 1982

Methods	Randomization and allocation concealment: "randomly allocated". Blinding: not reported. Losses to follow up: none - there were 2 failures in the caudal with bupivacaine only group (1 technical failure due to an anatomical abnormality and 1 in a child with emotional disturbance).
Participants	60 inpatient boys admitted consecutively to hospital for circumcision. No age range given but mean age 5.6-6.5 in the three groups. Exclusion criteria: none reported. Setting: UK
Interventions	CAUDAL (CAUDAL or CAUDAL+OPIOID) versus PARENTERAL OPIOID Caudal: 0.5% bupivacaine, 0.5 ml/kg (n=20). Caudal: 0.5% bupivacaine and morphine 0.2 mg/ml, 0.5 ml/kg (n=20). Diamorphine 0.07 mg/kg, 0.05 mg/kg given IV during early part of operation and 0.02 mg/kg given IM when surgery completed (n = 20).
Outcomes	Pain: No criteria for rescue analgesia although paracetamol elixir said to be given by mouth if required. However diamorphine was given in the ward for two patients in the bupivacaine only caudal group due to block failures. 10-cm linear analogue scale of "anaesthetised child" at one end and "screaming and uncontrollable" at the other. Completed every 5 minutes for 1st hour, every 15 minutes for second hour then hourly for 4 more hours. Assessed by paediatric ward sister and a small number of staff nurses under her supervision. Number of patients vomiting.
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

May 1982

Methods	Randomization and allocation concealment: random numbers after induction of GA, no further details reported. Blinding: Both patients and outcome assessors blinded. Losses to follow up: none reported.
Participants	44 healthy boys aged 9 months to 9 years, presenting for circumcision as day cases. Setting: UK
Interventions	CAUDAL versus PARENTERAL Caudal (n = 21): 0.25% bupivacaine, 0.5 ml/kg. Control (n = 23): buprenorphine 3 ug/kg IM.
Outcomes	Pain: No formal criteria for rescue analgesia. Pain assessed on 3 point scale on waking and at 2 hours postop. 3 further assessments by parents over next 24 hours with results via returned questionnaire. No record of how many questionnaires returned. Need for additional analgesia (aspirin) both in and out of hospital noted. Complications: not formally studied. Nausea and vomiting: noted in recovery and by returned questionnaire.

Caudal epidural block versus other methods of postoperative pain relief for circumcision in boys (Review)

May 1982 (Continued)

Micturition: not studied.
All assessed in postoperative period but unclear how many questionnaires about later events returned.

Notes

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Vater 1985

Methods	Randomization: after induction of GA - no other details. Blinding: "double blind" - dressing applied to each of two possible puncture sites in every child. Losses to follow up: none reported, but the 3 boys in whom the block did not work were excluded - we restored these participants for the outcome of rescue analgesia and used a denominator of 25 in each group for the other outcomes.
Participants	50 boys aged 1-13 years, admitted to day ward. Setting: UK
Interventions	CAUDAL versus DNPB Caudal (n = 25): 0.25% bupivacaine 0.5 ml/kg. DBPB (n = 25): 0.5% bupivacaine 3 ml (1-5 years) or 4 ml (5-13 years) via 23G needle.
Outcomes	Pain: scored on 3-point scale (good, fair, poor) at 2 and 4 hours. Rescue analgesia administered if pain relief deemed "poor" (required IM morphine sulphate within 1 hour of surgery). Time to first micturition, standing unaided, and oral fluids requested by child. After discharge questionnaire at 6,8, and 24 hours regarding pain (verbal rating score) and analgesic use, vomiting, micturition at home and mobilization.
Notes	Unpremedicated; inhalational or intravenous induction. Maintenance using spontaneous breathing of nitrous oxide/oxygen and halothane. Same anaesthetist performed all blocks.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Weksler 2005

Methods	Randomization and allocation concealment: "allocated randomly" "lottery of closed envelopes". Blinding: Induction-incision time was recorded by a nurse who was unaware of the block technique; an anaesthesiologist not involved in the study reviewed the anaesthesia monitor records; a nurse who was unaware of the study protocol, assessed the child's pain in the recovery room. Losses to follow up: not reported.
Participants	100 ASA I and II boys aged 3 to 8 years undergoing circumcision for religious reasons; day surgery.

Weksler 2005 (Continued)

Setting: hospital in Israel

Interventions	CAUDAL versus DNPB Caudal (n = 50): 1 ml/kg body weight of 0.25% bupivacaine (up to 20 ml), in lateral position. DNPB (n = 50): bupivacaine (0.5% 0.2 ml/kg) injected into the two compartments of the subpubic space, with an additional ventral infiltration of a small volume of bupivacaine (0.1 ml/kg) along the raphe of the penis.
Outcomes	Pain (five point face pain assessment - excruciating, severe, moderate, some, no pain) - 10-cm VAS. Analgesia (15 mg/kg of oral paracetamol given as postoperative pain relief for severe or excruciating pain). Rescue analgesia (paracetamol in recovery room). Any analgesia (assumed that 2 boys who had rescue analgesia (in the caudal group) were different boys from the 10 who had paracetamol at home). Induction-incision time (time interval from the beginning of the halothane administration until the beginning of surgery). Complications: haematoma at base of penis motor block tachycardia phonation movement Nausea and vomiting Time to discharge Parental satisfaction (10-cm VAS: 0 = not satisfied at all to 10 = extraordinarily satisfied).
Notes	SD of time to discharge for the caudal group is reported was 4.6 min - we have assumed that this should be 46 min.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

White 1983

Methods	Randomization and allocation concealment: Immediately before induction. No details of randomisation technique. Blinding: Outcome assessor blinded. Patient not formally blinded. Losses to follow up: None reported.
Participants	50 boys aged 2-12 years undergoing circumcision for medical indications as day patients. Exclusion criteria: none noted. Setting: UK
Interventions	CAUDAL versus DNPB Caudal (n = 23): 0.5% bupivacaine 0.5 ml/year of age. DNPB: bupivacaine 0.5% 0.2 ml/kg.
Outcomes	Pain: Need for rescue analgesia assessed by anaesthetist in recovery. Criteria for rescue analgesia not stated. Time to first evidence of pain. Need for paracetamol after discharge, quality of night's sleep (questionnaire returned by patient's family). Other Outcomes: Incidence of leg weakness and haematoma.

Caudal epidural block versus other methods of postoperative pain relief for circumcision in boys (Review)

White 1983 (Continued)

Notes

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

DNPB = dorsal nerve penile block

EMLA = eutectic (emulsified) mixture of local anaesthetics

GA = general anaesthesia

IM = intramuscular

IV = intravenous

PONV = postoperative nausea and vomiting

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Grosse 1988	Not randomized - 100 boys given general anaesthesia only, then next 100 given caudal pethidine.
Irwin 1996	An appropriate dose according to age and/or weight was not defined in the penile block group: 0.5% bupivacaine 1-2 ml using 25G needle around the proximal shaft of the penis (irrespective of age/weight).
Londergan 1994	Circumcision results not reported separately from other types of surgery.
Yeoman 1983	Alternate assignment to treatment groups.

DATA AND ANALYSES

Comparison 1. Caudal analgesia versus parenteral analgesia

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Need for analgesia	4		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
1.1 need for any analgesia (rescue or other)	4	235	Risk Ratio (M-H, Random, 95% CI)	0.41 [0.12, 1.43]
1.2 need for rescue analgesia	2	131	Risk Ratio (M-H, Random, 95% CI)	0.52 [0.05, 5.72]
1.3 other analgesia	2	104	Risk Ratio (M-H, Random, 95% CI)	0.54 [0.04, 6.88]
2 Nausea or vomiting	4	235	Risk Ratio (M-H, Fixed, 95% CI)	0.61 [0.36, 1.05]

Analysis 1.1. Comparison 1 Caudal analgesia versus parenteral analgesia, Outcome 1 Need for analgesia.

Analysis 1.2. Comparison 1 Caudal analgesia versus parenteral analgesia, Outcome 2 Nausea or vomiting.

Comparison 2. Caudal analgesia versus dorsal nerve penile block

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Need for any analgesia (rescue or other)	4	336	Risk Ratio (M-H, Random, 95% CI)	1.25 [0.64, 2.44]
2 Need for rescue analgesia	4	336	Risk Ratio (M-H, Fixed, 95% CI)	2.71 [0.81, 9.09]
3 Other analgesia	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
3.1 paracetamol up to 2 hours postop	1	126	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.01, 8.03]
3.2 paracetamol on day of operation	1	126	Risk Ratio (M-H, Fixed, 95% CI)	0.92 [0.68, 1.24]
3.3 paracetamol at home	1	100	Risk Ratio (M-H, Fixed, 95% CI)	1.67 [0.66, 4.24]
4 Pain score	1	100	Mean Difference (IV, Fixed, 95% CI)	0.5 [-0.17, 1.17]
5 Complications	5		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
5.1 nausea and vomiting	4	336	Risk Ratio (M-H, Random, 95% CI)	1.88 [0.70, 5.04]
5.2 motor block	1	100	Risk Ratio (M-H, Random, 95% CI)	17.0 [1.01, 286.82]
5.3 motor/leg weakness	2	110	Risk Ratio (M-H, Random, 95% CI)	10.07 [1.25, 81.32]
5.4 bleeding	1	126	Risk Ratio (M-H, Random, 95% CI)	1.0 [0.06, 15.64]
5.5 bruising of skin/at needle site	3	274	Risk Ratio (M-H, Random, 95% CI)	0.34 [0.07, 1.82]
5.6 tachycardia	1	100	Risk Ratio (M-H, Random, 95% CI)	2.0 [0.53, 7.56]
5.7 phonation	1	100	Risk Ratio (M-H, Random, 95% CI)	3.00 [0.32, 27.87]
5.8 movement	1	100	Risk Ratio (M-H, Random, 95% CI)	0.20 [0.01, 4.06]
5.9 eating disturbance	1	57	Risk Ratio (M-H, Random, 95% CI)	0.89 [0.27, 2.97]
5.10 sleep disturbance	1	57	Risk Ratio (M-H, Random, 95% CI)	1.30 [0.73, 2.29]
5.11 behavioural disturbance	1	57	Risk Ratio (M-H, Random, 95% CI)	0.91 [0.45, 1.85]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5.12 urinary retention	1	57	Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
6 Time to discharge home (mins)	1	100	Mean Difference (IV, Fixed, 95% CI)	37.0 [18.97, 55.03]
7 Parental satisfaction	1	100	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-0.58, 0.38]
8 Procedural time (mins)	1	100	Mean Difference (IV, Fixed, 95% CI)	1.90 [1.33, 2.47]
9 Hospital stay			Other data	No numeric data
9.1 recovery room stay			Other data	No numeric data

Analysis 2.1. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 1 Need for any analgesia (rescue or other).

Analysis 2.2. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 2 Need for rescue analgesia.

Analysis 2.3. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 3 Other analgesia.

Analysis 2.4. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 4 Pain score.

Analysis 2.5. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 5 Complications.

Analysis 2.6. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 6 Time to discharge home (mins).

Analysis 2.7. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 7 Parental satisfaction.

Analysis 2.8. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 8 Procedural time (mins).

Analysis 2.9. Comparison 2 Caudal analgesia versus dorsal nerve penile block, Outcome 9 Hospital stay.

Study	Hospital stay				p value
	Caudal (mean) mins	Caudal (range), mins	DNBP (mean) mins	DNBP (range) mins	
recovery room stay					
Mak 2001	15.2 (n=63)	10-30	15.5 (n=63)	(10-25)	pns

Comparison 3. Caudal analgesia versus rectal or intravenous

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Need for any analgesia (rescue or other)	2	164	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.51, 1.27]
2 Need for rescue analgesia	1	124	Risk Ratio (M-H, Fixed, 95% CI)	4.84 [0.24, 98.88]
3 Other analgesia	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
3.1 acetaminophen before discharge	1	40	Risk Ratio (M-H, Fixed, 95% CI)	0.6 [0.35, 1.04]
3.2 paracetamol up to 2 hours postop	1	124	Risk Ratio (M-H, Fixed, 95% CI)	0.19 [0.01, 3.96]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.3 paracetamol on day of operation	1	124	Risk Ratio (M-H, Fixed, 95% CI)	1.03 [0.75, 1.41]
4 Complications	2		Risk Ratio (M-H, Random, 95% CI)	Subtotals only
4.1 nausea and vomiting	2	164	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.14, 5.53]
4.2 bleeding	1	124	Risk Ratio (M-H, Random, 95% CI)	0.97 [0.06, 15.14]
4.3 bruising of skin/at needle site	1	124	Risk Ratio (M-H, Random, 95% CI)	2.91 [0.12, 69.99]
5 Hospital stay			Other data	No numeric data
5.1 recovery room stay			Other data	No numeric data

Analysis 3.1. Comparison 3 Caudal analgesia versus rectal or intravenous, Outcome 1 Need for any analgesia (rescue or other).

Analysis 3.2. Comparison 3 Caudal analgesia versus rectal or intravenous, Outcome 2 Need for rescue analgesia.

Analysis 3.3. Comparison 3 Caudal analgesia versus rectal or intravenous, Outcome 3 Other analgesia.

Analysis 3.4. Comparison 3 Caudal analgesia versus rectal or intravenous, Outcome 4 Complications.

Analysis 3.5. Comparison 3 Caudal analgesia versus rectal or intravenous, Outcome 5 Hospital stay.

Study	Hospital stay				p value
	caudal (mean) mins	caudal (range) mins	rect/i.v. (mean) min	rect/i.v. (range) mi	
recovery room stay					
Mak 2001	15.2 (n=61)	10-30	14.6 (n=61)	10-25	pns

APPENDICES

Appendix 1. CENTRAL (*The Cochrane Library*) (Issue 1, 2008)

#1 MeSH descriptor Circumcision explode all trees
#2 (Penis in All Text near/6 surg* in All Text)
#3 (penile in All Text near/6 surg* in All Text)
#4 foreskin in All Text
#5 prepuce in All Text
#6 (prepuce in All Text and (Excis* in All Text or rem?v* in All Text))
#7 (foreskin in All Text and (Excis* in All Text or rem?v* in All Text))
#8 (prepuce in All Text near/6 rem?v* in All Text)
#9 (foreskin in All Text near/6 excis* in All Text)
#10 (foreskin in All Text near/6 rem?v* in All Text)
#11 (circumcis* in All Text or circ?ncis* in All Text or beschneidung in All Text)
#12 (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11)
#13 MeSH descriptor Anesthesia, Caudal explode all trees
#14 (Anesthesia in All Text or Epidural in All Text)
#15 (Nerve in All Text and Block in All Text)
#16 ((block* in All Text near/6 caudal in All Text) or (caudal in All Text and block* in All Text))
#17 (block* in All Text near/6 dorsal in All Text)
#18 (((block* in All Text near/6 subcutaneous in All Text) and ring in All Text) or (subcutaneous in All Text and ring in All Text and block* in All Text))
#19 ((block* in All Text near/6 penile in All Text) or (penile in All Text and block* in All Text))
#20 (nerv* in All Text near/6 block* in All Text)
#21 (an?esth* in All Text or analg* in All Text)#22 MeSH descriptor Pain, Postoperative explode all trees
#23 MeSH descriptor Postoperative Care explode all trees
#24 (#13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23)#25(#13 and #24)

Appendix 2. SilverPlatter MEDLINE (WebSPIRS) April 2008

#1 explode "Circumcision-" / all SUBHEADINGS in MIME,MJME,PT
#2 Penis near (operat* or surg*)
#3 foreskin
#4 prepuce
#5 prepuce and (Excis* or rem?v*)
#6 foreskin and (Excis* or rem?v*)
#7 prepuce near (Excis* or rem?v*)
#8 foreskin near (Excis* or rem?v*)
#9 circumcis* or circ?ncis* or beschneidung
#10 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9
#11 explode Anesthesia, Caudal/ all subheadings
#12 explode Anesthesia, Epidural/ all subheadings
#13 explode "Nerve-Block" / all SUBHEADINGS in MIME,MJME,PT
#14 explode Analgesics-Opioid/ all subheadings
#15 block* near (caudal or dorsal nerv* or subcutaneous ring or penile)
#16 block* and (caudal or dorsal nerv* or subcutaneous ring or penile)
#17 topical near (analges* or an?esthe*)
#18 post?operativ* near analg*
#19 nerv* block*
#20 "Pain-Postoperative" / all SUBHEADINGS in MIME,MJME,PT

#21 "Postoperative-Care" / all SUBHEADINGS in MIME,MJME,PT
 #22 an?esth* or analg*
 #23 #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22
 #24 #10 and #23
 #25 RANDOMIZED-CONTROLLED-TRIAL in PT
 #26 CONTROLLED-CLINICAL-TRIAL in PT
 #27 RANDOMIZED-CONTROLLED-TRIALS
 #28 RANDOM-ALLOCATION
 #29 DOUBLE-BLIND-METHOD
 #30 SINGLE-BLIND-METHOD
 #31 #25 or #26 or #27 or #28 or #29 or #30
 #32 (TG=ANIMALS) not ((TG=HUMAN) and (TG=ANIMALS))
 #33 #31 not #32
 #34 CLINICAL-TRIAL in PT
 #35 explode CLINICAL-TRIALS / all subheadings
 #36 (clin* near trial*) in TI
 #37 (clin* near trial*) in AB
 #38 (singl* or doubl* or trebl* or tripl*) near (blind* or mask*)
 #39 (#38 in TI) or (#38 in AB)
 #40 PLACEBOS
 #41 placebo* in TI
 #42 placebo* in AB
 #43 random* in TI
 #44 random* in AB
 #45 RESEARCH-DESIGN
 #46 #34 or #35 or #36 or #37 or #39 or #40 or #41 or #42 or #43 or #44 or #45
 #47 (TG=ANIMALS) not ((TG=HUMAN) and (TG=ANIMALS))
 #48 #46 not #47
 #49 #48 not #33
 #50 TG=COMPARATIVE-STUDY
 #51 explode EVALUATION-STUDIES / all subheadings
 #52 FOLLOW-UP-STUDIES
 #53 PROSPECTIVE-STUDIES
 #54 control* or prospectiv* or volunteer*
 #55 (#54 in TI) or (#54 in AB)
 #56 #50 or #51 or #52 or #53 or #55
 #57 (TG=ANIMALS) not ((TG=HUMAN) and (TG=ANIMALS))
 #58 #56 not #57(749506 records)
 #59 #58 not (#33 or #49)
 #60 #33 or #49 or #59
 #61 #24 and #60

Appendix 3. SilverPlatter EMBASE (WebSPIRS) April 2007

#1 explode Circumcision/ all subheadings
 #2 explode "prepuce-" / all SUBHEADINGS in DEM,DER,DRM,DRR
 #3 Penis near (operat* or surg*)
 #4 foreskin
 #5 prepuce
 #6 prepuce and (Excis* or rem?v*)
 #7 foreskin and (Excis* or rem?v*)
 #8 prepuce near (Excis* or rem?v*)
 #9 foreskin near (Excis* or rem?v*)
 #10 circumcis* or circ?ncis* or beschneidung
 #11 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10
 #12 explode "caudal-anesthesia" / all SUBHEADINGS in DEM,DER,DRM,DRR
 #13 explode "epidural-anesthesia" / all SUBHEADINGS in DEM,DER,DRM,DRR
 #14 explode "nerve-block" / all SUBHEADINGS in DEM,DER,DRM,DRR
 #15 "analgesic-agent" / all SUBHEADINGS in DEM,DER,DRM,DRR
 #16 block* near (caudal or dorsal nerv* or subcutaneous ring or penile)
 #17 block* and (caudal or dorsal nerv* or subcutaneous ring or penile)
 #18 topical near (analges* or an?esthe*)

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#19 post?operativ* near analg*
#20 nerv* block*
#21 "postoperative-pain" / all SUBHEADINGS in DEM,DER,DRM,DRR
#22 explode "postoperative-analgesia" / all SUBHEADINGS in DEM,DER,DRM,DRR
#23 explode "postoperative-care" / all SUBHEADINGS in DEM,DER,DRM,DRR
#24 an?esth* or analg*(83311 records)
#25 #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24
#26 #11 and #25(180 records)
#27 explode "randomized-controlled-trial" / all SUBHEADINGS in DEM,DER,DRM,DRR
#28 (randomi?ed controlled trial*) in TI, AB
#29 random*
#30 explode "randomization-" / all SUBHEADINGS in DEM,DER,DRM,DRR
#31 randomi?ation
#32 explode "clinical-trial" / all SUBHEADINGS in DEM,DER,DRM,DRR
#33 explode multicenter-study / all subheadings
#34 multi?cent*
#35 explode phase-4-clinical-trial / all subheadings or explode double-blind-procedure / all subheadings or explode single-blind-procedure / all subheadings
#36 (RANDOM* or CROSS?OVER* or FACTORIAL* or PLACEBO* or VOLUNTEER*) in TI, AB, TW
#37 ((SINGL* or DOUBL* or TREBL* or TRIPL*) near (BLIND* or MASK*)) in TI,AB
#38 explode "follow-up" / all SUBHEADINGS in DEM,DER,DRM,DRR
#39 (follow?up near stud*) in TI, AB
#40 evaluation stud*
#41 explode "prospective-study" / all SUBHEADINGS in DEM,DER,DRM,DRR
#42 prospective?stud*
#43 research near design*
#44 explode "comparative-study" / all SUBHEADINGS in DEM,DER,DRM,DRR
#45 clinic* near trial*
#46 #27 or #28 or #29 or #30 or #29 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 or #44 or #45
#47 (human) in DER
#48 (animal or nonhuman) in DER
#49 #47 and #48
#50 #48 not #49
#51 #46 not #50
#52 #26 and #51
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WHAT'S NEW

Date	Event	Description
4 October 2010	Amended	Contact details updated.

HISTORY

Protocol first published: Issue 4, 2000

Review first published: Issue 2, 2003

Date	Event	Description
7 August 2008	New search has been performed	Search reran: previous search 2002; search reran to April 2008. Three new studies included; results changed but conclusions the same. In previous versions of this review we specified that quasi-randomized trials would be included (Cyna 2003). For the 2008 update on, we excluded quasi-randomized trials

Date	Event	Description
7 August 2008	New citation required but conclusions have not changed	New review team; review has undergone substantial work.
3 January 2007	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

Authors of original review ([Cyna 2003](#)) Cyna AM, Jha S, Parsons JE

For the 2008 update, Philippa Middleton and Allan Cyna assessed trial eligibility and extracted data. Philippa Middleton drafted the update and both review authors edited the draft review.

DECLARATIONS OF INTEREST

None known

SOURCES OF SUPPORT

Internal sources

- Discipline of Obstetrics and Gynaecology, The University of Adelaide, Australia.

External sources

- Commonwealth Department of Health and Ageing, Australia.

INDEX TERMS

Medical Subject Headings (MeSH)

Anesthesia, Caudal [*methods]; Anesthesia, Local [methods]; Circumcision, Male [*adverse effects]; Nerve Block [*methods]; Pain, Postoperative [*therapy]; Randomized Controlled Trials as Topic

MeSH check words

Child; Humans; Male