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Perioperative fluid therapy in children: a survey of current prescribing practice†

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Background. Fluid therapy in children may be associated with iatrogenic hyponatraemia. We surveyed anaesthetists' current fluid prescribing practice during the perioperative period, departmental fluid protocols and awareness of the concerns of the Royal College of Paediatrics and Child Health (RCPCH) about the use of dextrose 4%/saline 0.18% in children.

Methods. Questionnaire survey of 477 consultant anaesthetists in two training areas in the UK.

Results. Responses were received from 289 anaesthetists (60.6%)—responses from the 203 consultants that anaesthetized children were analysed. A total of 67.7% did not have a local departmental policy for fluid prescription, and 58.1% were unaware of the concerns of RCPCH. A total of 60.1% of anaesthetists said that they prescribed hypotonic dextrose saline solutions in the intraoperative period and 75.2% did so in the postoperative period. Anaesthetists working in specialist paediatric hospitals were 5.1 times more likely to prescribe isotonic fluids intraoperatively than those working in district hospitals (95% CI 1.48–17.65, P=0.01), but they all prescribed hypotonic dextrose saline solutions postoperatively. The Holliday and Segar formula for maintenance fluid was quoted by 81.8% of anaesthetists; only 5.9% of anaesthetists would restrict fluids in the immediate postoperative period. Anaesthetists working in specialist paediatric hospitals were 13.2 times more likely to restrict fluids postoperatively than those working in district hospitals (95% CI 2.8–61.8, P=0.001).

Conclusions. The prescription of hypotonic dextrose saline solutions by anaesthetists may be putting children at risk from iatrogenic hyponatraemia. Departmental protocols for perioperative fluid prescription in children are uncommon. We suggest that national guidance is required.

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There have been more than 50 case reports of serious morbidity or death in previously healthy children associated with the administration on i.v. fluids and hospital-acquired hyponatraemia.[1] Deaths have been reported after both major and minor surgery in children, including tonsillectomy, orchidopexy, reduction of fractures and appendicectomy.[2–5] The postoperative course in these children is typified by progressive lethargy, headache, nausea and vomiting, followed by rapid deterioration to respiratory arrest and coma.[2] Fatal cerebral oedema occurring during surgery has also been reported.[3] Children have usually had continued administration of large volumes of hypotonic i.v. fluid in the presence of a low plasma sodium.[2 6 7] The deaths of three children believed to be as a result of hospital-acquired hyponatraemia is currently the subject of a public enquiry in Northern Ireland.[8] Central to discussion in the literature and also to the enquiry is whether too much fluid is being given, or the wrong type of fluid.[2 8–12]

†This article is accompanied by Editorial II.

There are several i.v. fluid solutions in common use in paediatric practice in the UK. Dextrose 4%/saline 0.18% and dextrose 2.5%/saline 0.45% are isotonic when administered but effectively hypotonic once the glucose has been metabolized; these are referred to as hypotonic solutions hereafter. After a report of another death, the use of dextrose 4%/saline 0.18% in children was discussed by the Medical Control Agency/Committee on Safety of Medicines and by the Joint Royal College of Paediatrics and Child Health (RCPCH)/Neonatal and Paediatric Pharmacists Standing Committee on Medicines in 2002. They concluded that the problem was an issue of clinical practice rather than product regulation and that dextrose 4%/saline 0.18% could continue to be used but should be prescribed carefully, especially to children in the postoperative period. Their concerns were communicated to the Royal College of Anaesthetists for dissemination to members. A letter was sent to College Tutors and Heads of Departments of Anaesthesia and the issue featured as a news item on the Royal College of Anaesthetists website in 2002. The letter was published in the College Bulletin in 2003.[13]

It is our practice, as specialist paediatric anaesthetists, to only use solutions in the intraoperative period that are isotonic with plasma, compound sodium lactate solution (Hartmann's solution) being our standard intraoperative maintenance fluid. This solution is used for children of all ages, with or without added dextrose as required. However, in discussions with trainee anaesthetists and Operating Department Practitioners from non-specialist institutions, it seemed that the practice of non-specialist anaesthetists may vary.

We therefore conducted a survey of a sample of anaesthetists in the UK to find out about their perioperative fluid prescriptions for children, the existence of departmental protocols, whether they were aware of the concerns from the RCPCH and whether this had affected their prescribing practice.

Methods

We surveyed all the consultant anaesthetists in two training Schools of Anaesthesia in the UK, thus including anaesthetists working in a variety of different hospital settings, both specialist and non-specialist (Bristol School of Anaesthesia and the North Western School of Anaesthesia). Names and addresses of hospitals were obtained from the Royal College of Anaesthetists College Tutors website. The departmental administrator for each hospital was contacted and a survey sent to all 477 consultant anaesthetists in the two Schools in May 2004 with a numbered postage-paid reply envelope. An independent research fellow opened the replies. Anonymity was maintained by separating the completed surveys from the envelope, noting the identifying number. Non-respondents were contacted by telephone or email after 4 weeks and then 6 weeks.

The questionnaire included details of the setting in which the anaesthetist worked, their paediatric anaesthesia training, the frequency with which they anaesthetized children, whether they had a departmental protocol for perioperative fluid administration and whether they were aware of the warning letter from the RCPCH concerning the use of dextrose 4%/saline 0.18% in children. They were asked about their choice of fluid for routine intraoperative maintenance and postoperative maintenance, what type of fluid they would prescribe as a fluid bolus in case of hypovolaemia and the volume of postoperative maintenance fluid they would routinely prescribe. There were four fluid choices: saline 0.9% or Hartmann's solution, both isotonic with plasma; dextrose 2.5%/saline 0.45% or dextrose 4%/saline 0.18% (hypotonic dextrose saline solutions); and a chance to specify 'other'. A pilot study was performed to exclude ambiguous questions. Multi-centre Research Ethics Committee approval was obtained from the South West Multi-centre Research Ethics Committee.

Statistical analyses

We used logistic regression to compare the use of isotonic fluids (saline 0.9% or Hartmann's solution) intraoperatively and postoperatively within different hospital settings and between anaesthetists with differing years of practice as a consultant, training, frequency of anaesthetizing children and knowledge/response to the RCPCH warning. Univariate odds ratios are presented and multivariable models were used to investigate whether associations found were independent. Results are presented with 95% confidence intervals (95% CI).

Results

A total of 289 replies were received giving a response rate of 60.6%. Eighty-six of these anaesthetists indicated that they never anaesthetized children and their replies were not analysed further. The results are based on the remaining 203 respondents.

One hundred and twenty-three (60.6%) respondents worked in district hospitals, 67 (33.0%) in teaching hospitals and 13 (6.4%) in specialized paediatric units. A total of 25.6% indicated that they had not received any specific training in paediatric practice, 22.7% had received training in paediatric anaesthesia for 3 months or less, 23.6% for 6–12 months and 27.6% had more than 12 months training. A total of 59.1% of respondents currently anaesthetized children occasionally, 32.0% had regular paediatric sessions amounting to <50% of their workload ('interest' in paediatric anaesthesia) and 7.9% had >50% of their workload made up of paediatric anaesthetic sessions ('specialist' paediatric anaesthetists).

Eighty-five (41.9%) respondents were aware of the RCPCH warning of November 2002, and of these only 26 had changed their practice as a result. A total of 67.7% indicated that they had no departmental policy regarding perioperative fluids in children.