transfusion of one or more units of packed red cells. Secondary outcome measures included postoperative haemoglobin, the number of units of packed red cells used, readmission rates for maternal complications, iso-immunisation rates and other adverse events.

Of the 80 eligible women, 57 were randomised over a 27-month period; 25% who were approached declined consent. All deliveries were at term and the main indications were previous caesarean delivery and breech presentation; all but one received neuraxial anaesthesia. Of 30 women randomised to IOCS, it was set up and deployed in 28 (93%), with sufficient blood collected to enable return of an average of 284 ± 113 mL of blood to five women. Intraoperative haemorrhage due to undiagnosed placenta accreta resulted in one woman in the routine treatment group receiving IOCS with 248 mL of salvaged blood plus two units of allogeneic blood. She had further postpartum bleeding and was given four units of fresh frozen plasma. No woman in the IOCS group required allogeneic transfusion compared to 3.7% in the routine treatment group. Two other women were admitted to the high dependency unit: one for observation of a known cardiac problem and one in the IOCS group following an intraoperative haemorrhage where 507 mL of blood was returned but no allogeneic transfusion given.

In this pilot study, only women undergoing elective caesarean delivery were eligible, as there were insufficient resources to inform women of the study antenatally and provide cover for consent, randomisation and deployment of the cell salvage machine. Caesarean sections performed as emergencies are often for indications associated with particularly high risk of haemorrhage including antepartum haemorrhage. Any substantive trial of routine IOCS would need to recruit large numbers of both elective and emergency caesarean deliveries to detect any differences in effectiveness between the groups. Intraoperative cell salvage simultaneously reduces the need for donor blood transfusion, prevents anaemia and could avoid the serious morbidity associated with haemorrhage. Whether it is as effective for caesarean delivery as in other settings requires examination. A randomised controlled trial with health economic evaluation is underway in the UK (ISRCTN66118656, <http://blizard.qmul.ac.uk/research-generation/681-salvo.html>) and obstetricians and anaesthetists are encouraged to participate.

J. Geoghegan, L. Middleton,
P. Moore, G. Subseson, K. Khan, J. Daniels
Birmingham Women's Hospital NHS Foundation Trust
Birmingham, UK
E-mail address: james.geoghegan@nhs.net

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Management of persistent cerebrospinal fluid leak using tissue adhesive

Persistent cerebrospinal fluid (CSF) leak after dural puncture is a rare but potentially concerning complication of neuraxial anesthesia. Persistent CSF leak from subarachnoid-cutaneous fistulas has been reported after removal of epidural and spinal catheters and after spinal surgery.^{1–4} Sequelae of subarachnoid-cutaneous fistulas include meningitis, pseudo-meningocele formation, and/or entrapment of nerve rootlets, although these have only been reported in neurosurgical and spinal surgery populations.⁵ When a CSF leak occurs after neuraxial anesthesia, the anesthesiologist is confronted with a dilemma as to the appropriate course of action for definitive treatment.

We recently encountered a patient who suffered an inadvertent dural puncture with a 17-gauge Tuohy needle during attempted epidural placement for labor analgesia. A spinal catheter was left in place and used for analgesia. She delivered uneventfully 150 min later. The spinal catheter was removed 24 h after the dural puncture. Three hours after catheter removal, we were informed of significant clear fluid leaking from the catheter site. Gauze and Tegaderm™ were initially placed, but fluid was noted to have pooled under the Tegaderm™ after one hour, so the site was cleaned and a pressure dressing applied. Fluid was still noted to be leaking one day later, although the patient had no postdural puncture headache (PDPH) symptoms. After discussion with the anesthesia team she opted to be discharged home with daily telephone follow-up and clear instructions to contact the team if the leak persisted or if she developed a headache or fever. One day later, the patient returned to the hospital due to significant persistent CSF leak. After consulting with the neurosurgical team, we applied a topical skin adhesive (Covidien SwiftSet™) and Steri-strips™ to close the skin puncture site under sterile conditions. CSF leakage stopped immediately following application of the tissue adhesive. She was discharged home with instructions to remove the Steri-strips™ after five days if there was no

further fluid leak, and to avoid immersion bathing and scrubbing the site for five days so as to not interfere with the SwiftSet™ (<http://surgical.covidien.com/products/wound-closure/topical-skin-adhesives>). The patient reported no further CSF leak for the next week of follow-up.

It has been suggested that CSF leak after neuraxial anesthesia might be an underreported phenomenon.^{1,3} It is likely, however, that most fluid leaks are more minor and transient than in our case. Furthermore, in some cases fluid might not be CSF but could be tissue edema or extravasation of epidural local anesthetic solutions. Although we did not specifically test the fluid to confirm that it was CSF,¹ we believe the fluid was very likely CSF as no epidural solutions were injected, only a few milliliters of local anesthetic were injected intrathecally, and the patient was thin and non-edematous. Currently, there are no guidelines on management of CSF leaks for anesthesia providers, although a conservative approach can be used with mild leaks as most resolve spontaneously.^{1,3} In the rare case of large volume CSF leak, as would be seen in the surgical population, the definitive treatment is surgical exploration and/or suturing.⁵ Skin suturing was suggested as an option by our neurosurgery colleagues; however, we elected to apply tissue adhesive and adhesive strips with a plan to use suturing if this approach failed. Use of tissue adhesive for managing CSF leaks has been previously reported in the surgical literature,⁶ but not following inadvertent dural puncture with a Tuohy needle.

Of note, our patient remained free of PDPH symptoms despite losing a significant amount of CSF. Interestingly, previous case reports have revealed a lack of headache or mild headache that resolved spontaneously in seven of nine patients who had persistent CSF leak after neuraxial anesthesia.¹ Adding our patient to this small group would result in a 20% incidence of PDPH in patients with significant persistent CSF leak as opposed to the typical incidence of 70–80% following inadvertent dural puncture with a Tuohy needle.^{7,8} It is not known whether this association is coincidental or if there is altered CSF flow dynamics in these patients, which leads to an increased propensity to develop persistent CSF leak but is protective against PDPH.

In conclusion, we believe this is the first report of using tissue adhesive for persistent CSF leak following unintentional dural puncture. We would suggest this as a viable first alternative to suturing and/or surgical exploration for anesthesia providers who are faced with this problem.

J.R. Privratsky, S.L. McCartney,
T.K. Allen, A.S. Habib

Department of Anesthesiology

Duke University Medical Center, Durham, NC, USA

E-mail address: habib001@dm.duke.edu

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Anaesthetic management of a parturient with uncorrected tetralogy of Fallot undergoing caesarean section

Tetralogy of Fallot (TOF) is the commonest form of cyanotic congenital heart defect, amounting to 10% of all cases. With ongoing advances in surgical techniques, many of these patients now reach childbearing age and often tolerate pregnancy relatively well. However, without surgical intervention, 70% of those with TOF die in the first decade and only about 3% survive into the fourth decade. Therefore, presentation of uncorrected TOF in pregnancy is rare¹ and poses a significant risk to both mother and baby.^{2,3}

We report the case of a 29-year-old G1P0 parturient, recently arrived from the Cameroon, who presented to our institution at 30 weeks of gestation. Past medical history included a heart murmur (without definitive diagnosis) and poor exercise tolerance. On examination a pan-systolic murmur, clubbing and oxygen saturations of 89% were noted. Echocardiography showed TOF with 50% aorta override, a large sub-aortic ventricular septal defect with bidirectional shunting, and pulmonary stenosis (pressure gradient 80 mmHg). The right ventricle was moderately dilated and hypertrophied. The parturient was managed with specialist multidisciplinary care and remained relatively well until 34 weeks, when she developed worsening dyspnoea and exertional chest