4. Gilliam M, Rosenberg D, Davis F. The likelihood of placenta praevia with greater number of caesarean deliveries and higher parity. *Obstet Gynecol* 2002;**99**:976–80.
5. Wu S, Kocherginsky M, Hibbard J. Abnormal placentation: twenty-year analysis. *Am J Obstet Gynecol* 2005;**192**:1458–61.
6. Lewis G, editor. *Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer – 2003–05.* The seventh report on confidential enquires into maternal deaths in the United Kingdom. London: CEMACH; 2007.
7. Kayem G, Davey C, Goffinet F, Thomas C, Clement D, Cabrol D. Conservative versus extirpative management in cases of placenta accreta. *Obstet Gynecol* 2004;**104**:531–6.
8. Shih JC, Liu KL, Shyu MK. Temporary balloon occlusion of the common iliac artery: new approach to bleeding control during caesarean hysterectomy for placenta percreta. *Am J Obstet Gynecol* 2005;**193**:1756–8.
9. Dubois J, Garel L, Grignon A, Lemay M, Leduc L. Placenta percreta: balloon occlusion and embolisation of the internal iliac arteries to reduce intraoperative blood losses. *Am J Obstet Gynecol* 1997;**176**:723–6.
10. Ojala K, Perala J, Kariniemi J, Ranta P, Raudaskoski T, Tekay A. Arterial embolisation and prophylactic catheterisation for the treatment for severe obstetric hemorrhage. *Acta Obstet Gynecol Scand* 2005;**84**:1075–80.
11. Mok M, Heidemann B, Dundas K, Gillespie I, Clark V. Interventional radiology in women with suspected placenta accreta undergoing caesarean section. *Int J Obstet Anesth* 2008;**17**:255–61.
12. Levine AB, Kuhlman K, Bonn J. Placenta accreta: comparison of cases managed with and without pelvic artery balloon catheters. *J Matern Fetal Med* 1999;**8**:173–6.
13. Bodner LJ, Nosher JL, Gribbin C, Siegel RL, Beale S, Scorza W. Balloon-assisted occlusion of the internal iliac arteries in patients with placenta accreta/percreta. *Cardiovasc Intervent Radiol* 2006;**29**:354–61.
14. Greenwood LH, Glickman MG, Schwartz PE, Morse SS, Denny DF. Obstetric and non-malignant gynecologic bleeding: treatment with angiographic embolization. *Radiology* 1987;**164**:155–9.
15. Gilbert WM, Moore TR, Resnik R, Doemeny J, Chin H, Bookstein JJ. Angiographic embolization in the management of hemorrhagic complications of pregnancy. *Am J Obstet Gynecol* 1992;**166**:493–7.
16. Deux J-F, Bazot M, Le Blanche AF et al. Is selective embolisation of uterine arteries a safe alternative to hysterectomy in patients with postpartum hemorrhage? *Am J Roentgenol* 2001;**177**:145–9.
17. Yamashita Y, Harada M, Yamamoto H et al. Transcatheter arterial embolization of obstetric and gynaecological bleeding: efficacy and clinical outcome. *Br J Radiol* 1994;**67**:530–4.
18. Sewell MF, Rosenblum D, Ehrengerg H. Arterial embolus during common iliac balloon catheterisation at cesarean hysterectomy. *Obstet Gynecol* 2006;**108**:746–8.
19. Greenberg JI, Suliman A, Iranpour P, Angle N. Prophylactic balloon occlusion of the internal iliac arteries to treat abnormal placentation: a cautionary case. *Am J Obstet Gynecol* 2007;**197**:470.e1–4.
20. *The Royal College of Radiologists, The British Society of Interventional Radiology Achieving standards in vascular radiology*. The Royal College of Radiologists, London October 2007. <http://www.rcr.ac.uk/docs/radiology/pdf/Standards_Vascular_FinalOct07.pdf>; 2010 accessed 16.06.2010.
21. Manalo-Estrella P, Barker AE. Histopathologic findings in human aortic media associated with pregnancy. *Arch Pathol* 1967;**83**:336–41.
22. Kelly BA, Bond BC, Poston L. Aortic adaptation to pregnancy: elevated expression of matrix metalloproteinases-2 and -3 in rat gestation. *Mol Hum Reprod* 2004;**10**:331–7.
23. Kodali BS. Bloodless trilogy? Anesthesia, obstetrics and interventional radiology for caesarean delivery. *Int J Obstet Anesth* 2010;**19**:131–2.

0959-289X/$ - see front matter
doi:10.1016/j.ijoa.2010.07.014

Sequential drug verification errors resulting in wrong drug administration during caesarean section

S. Calderbank,[a] D.R. Uncles,[a] N. Burns,[b] H.K.C.D. Kariyawasam,[a] G.D.L. Allan[a]
[a] *Department of Anaesthesia, Worthing Hospital, Worthing, UK*
[b] *Pharmacy Department, Worthing Hospital, Worthing, UK*

ABSTRACT
An intravenous bolus of phentolamine was inadvertently given to a parturient during an emergency caesarean section following delivery of her infant when the intention had been to give an intravenous bolus of 5 IU Syntocinon. Root cause analysis identified a series of errors originating in the hospital pharmacy when one drug package was mistakenly issued in place of another. Subsequent checks failed to detect the original mistake. The final and most important check immediately before intravenous adminis-

Accepted July 2010
Correspondence to: Dr. David R. Uncles, Department of Anaesthesia, Western Sussex Hospitals NHS Trust, Worthing Hospital, Lyndhurst Road, Worthing West Sussex, BN11 2DH, UK.
E-mail addresses: David.Uncles@WSHT.nhs.uk Uncles.dr@doctors.org.uk

tration was also at fault. This case highlights a systems failure that permitted issue, transportation and administration of the wrong drug to a parturient. Robust measures to ensure avoidance of drug administration errors should be evaluated and introduced where possible.

Keywords: Drug administration error; Caesarean section; Syntocinon; Phentolamine

Introduction

In 2007 the National Patient Safety Agency (NPSA) published its findings on medication incidents.[1] Ninety two reports described severe harm or death during the 18-month study period. Most serious incidents recorded related to drugs administered intravenously. Drug administration errors associated with obstetric anaesthesia are known to occur.[2] Drug misidentification accounted for almost 37% of all errors in one prospective study conducted in a teaching hospital environment.[3] We report a case of an error involving repeated misidentification of a drug package by different healthcare professionals. Failure to identify the drug package correctly resulted in its transport to and storage in a location where the drug would not normally be kept and ultimately resulted in its inappropriate administration.

Case report

A 35-year-old 50 kg nulliparous woman required caesarean delivery due to failure to progress in labour. Epidural analgesia in labour had been provided via a catheter inserted at the L3-4 interspace. 10 mL each of 0.5% bupivacaine and 2% lidocaine supplemented with 50 μg fentanyl were given to establish a bilateral block to T3, confirmed with ethyl chloride spray, without appreciable alteration of blood pressure. Two anaesthetists jointly managed the patient.

At caesarean section, a healthy 3.6-kg female infant was delivered. Thereafter the intention was to administer 5 IU oxytocin (Syntocinon, Alliance Pharmaceuticals, Chippenham, UK) in accordance with both local and national guidelines. 0.5 mL of a clear colourless liquid, which had been drawn up in a 2 mL syringe and labelled ''oxytocin'' by one anaesthetist, was administered as a slow bolus by the second anaesthetist. Shortly after injection the systolic blood pressure fell from 112 to 88 mmHg, and responded to bolus doses of ephedrine totalling 9 mg. The syringe labelled ''oxytocin'' was checked with the ampoule from which the drug had been drawn, primarily to confirm the concentration of the Syntocinon given and exclude a dosing error. The opened ampoule was labelled phentolamine (Rogitine, Alliance Pharmaceuticals, Chippenham, UK) at a concentration of 10 mg/mL; consequently a 5 mg bolus had been given in error. Syntocinon 5 IU was immediately given to assist uterine contraction and the obstetricians informed of the reason for the delay in giving the correct drug. No additional vasopressor treatment was required. The incident was reported using our institutions's online critical incident system. The patient was informed. She experienced no further complications and was discharged home three days later.

The medicine stock-ordering list, which stipulates normal stock levels and is used to initiate drug replacement requests from the pharmacy, was reviewed. Phentolamine had not been requested. It was assumed that the error was an isolated consequence of accidental removal of the wrong drug package from the refrigerator where both phentolamine and Syntocinon were stored. Pharmacy staff reviewed their drug storage refrigerator, where three boxes of phentolamine were found mixed in amongst ten boxes of Syntocinon on the same shelf. Both drugs were supplied by the same generic drug manufacturer and packaged in similarly sized and coloured boxes using the manufacturer's corporate design (Figs. 1 and 2).

Following this incident, changes to prevent future error were implemented. Phentolamine and Syntocinon packages are now stored on separate shelves in the pharmacy refrigerator and phentolamine has been completely removed from the delivery suite stock-ordering list. The manufacturer, when notified that the similarity in packaging may have contributed to the administration error, has agreed to make changes to reduce misidentification.

Fig. 1 Phentolamine package.