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ORIGINAL ARTICLE

Normal urine output after elective caesarean section: an observational study

M.J. Mackenzie,[a] M.J. Woolnough,[a] N. Barrett,[a] M.R. Johnson,[b] S.M. Yentis[a]
[a] *Magill Department of Anaesthesia, Imperial College, Chelsea and Westminster Hospital, London, UK*
[b] *Academic Department of Obstetrics, Imperial College, Chelsea and Westminster Hospital, London, UK*

ABSTRACT
Background: When monitoring postoperative urine output there is no guidance specific to obstetrics. Factors such as peri-operative oxytocin infusions add further complexity. Our aim was to determine a normal range for urine output after elective caesarean section under neuraxial anaesthesia.
Methods: Sixty women were recruited and for 24 h from the time of urethral catheterisation, we recorded urine output and fluid input. We also measured intra-operative blood loss, use of prophylactic oxytocin infusion and markers of renal function. Data were compared with Mann–Whitney U-tests or paired t tests.
Results: Oxytocin infusions were used in 45 women (75%). Median (95% CI) urine output in the first 6 h was 0.8 (0.4–1.9) mL kg^{-1} h^{-1} in women receiving oxytocin compared to 1.4 (0.7–2.2) mL kg^{-1} h^{-1} in those who did not ($P = 0.02$). Urine output for all women at 12 and 18 h was 2.0 (0.7–5.7) and 1.9 (0.5–4.5) mL kg^{-1} h^{-1}. Blood loss was 0.4 (0.2–0.8) L in women with oxytocin infusions and 0.3 (0.1–0.4) L in those without ($P = 0.003$). Mean (SD) pre- and postoperative urine osmolality was 622.5 (185.7) and 293.0 (135.1) mosm/kg, respectively ($P < 0.0001$).
Conclusions: Urine output varied widely between subjects, especially after the first 6 h and was further reduced by the use of oxytocin infusion. This may have been a direct effect or related to increased blood loss in this group. Oxytocin use should be accounted for when setting a minimum postoperative urine output. We also found high pre-operative urine osmolalities suggesting significant dehydration.

Keywords: Urine output; Caesarean section; Oxytocin

Introduction

In women at risk of renal dysfunction due to pathological states such as preeclampsia and massive obstetric haemorrhage, we have found that following caesarean section, anaesthetic, obstetric and midwifery staff in our unit commonly rely on urine output as an indicator of cardiovascular stability and renal function. We make these inferences despite surprisingly limited information regarding normal urine output even in healthy women. Guidance on monitoring normally refers to the accepted minimum urine output of 0.5 mL kg^{-1} h^{-1} (or 40 mL/h) of the non-gravid state.[1] Pregnancy itself involves many physiological changes that affect the renal system. There is accumulation of water and salts along with increases in both plasma and extracellular fluid volume.[2,3] These, coupled with an increased cardiac output, result in an increase in renal blood flow of approximately 50–80%,[4] although this tends to decrease towards term and may be similar to the non-gravid state immediately post partum.[5] A multitude of different hormonal systems that are altered during pregnancy also have implications for renal function.[6] Conditions such as preeclampsia may involve renal impairment, and various potential influences on renal function such as neuraxial anaesthesia, blood loss, and drugs such as non-steroidal anti-inflammatory drugs and oxytocin during or after labour and delivery may be significant.[7–9] Without accurate information on normal urine output, it is hard to set goals for women who may be at risk of renal dysfunction. The aim of this observational study was to establish a normal range for urine output after elective caesarean section under neuraxial anaesthesia in healthy women.

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Correspondence to: Dr. Matthew J. Mackenzie FRCA, Department of Anaesthetics, East Surrey Hospital, Redhill RH1 5RH, UK.
E-mail address: drmmackenzie@mac.com

Methods

Following Research Ethics Committee approval and informed written consent, healthy women with a singleton pregnancy >36 weeks of gestation undergoing elective caesarean section under neuraxial anaesthesia were recruited to this observational study. Exclusions were maternal refusal to participate, use of general anaesthesia, complications of pregnancy, high risk of intra-operative haemorrhage, and pre-existing medical conditions or medications with effects on the cardiovascular or renal system.

Analysis of full blood count, renal function tests and serum osmolality was performed at the time of surgery. Women were questioned about their last oral intake of fluids (excluding ranitidine antacid prophylaxis) and neuraxial anaesthesia was established. The bladder was routinely catheterised and residual urine was emptied and its volume recorded. A urine sample was sent for urinary osmolality. Hourly urine output was then recorded from the time of catheterisation for 6 h at which time the volume of urine was recorded each time the catheter bag was emptied or, once the catheter was removed, each time a woman emptied her bladder for 24 h from catheter insertion. Participants were requested to keep a fluid balance diary and instructed to record all oral input and urine output, charted either by the midwife who emptied the catheter bag or by the woman herself after voiding, using a measuring jug. For analysis, urine output after the first 6 h was averaged to give an hourly flow rate.

Anaesthesia, intra- and postoperative fluid management and surgery were conducted according to standard practice and individual preferences of the anaesthetist and obstetrician. Standard haemodynamic variables were recorded as part of routine clinical care. Postoperative oral fluid intake was started at the woman's request, in line with our unit guidelines on early oral intake. Analgesic regimens in our unit are standardised and all women received either intrathecal (300–400 μg) or epidural (2.5–3.0 mg) diamorphine supplemented with rectal diclofenac 100 mg at the end of the procedure. Postoperative pain relief was managed with regular diclofenac 50 mg every 8 h, starting at least 16 h from the rectal dose, and codydramol (dihydrocodeine 10 mg paracetamol 500 g) 2 tablets 6 hourly. Prophylactic antibiotics were also standardised with intravenous cefuroxime 1.5 g given after clamping the umbilical cord and rectal metronidazole 1 g at the end of surgery.

Other data recorded were age; body mass index (BMI); parity; indication for caesarean section; anaesthetic details; fluids given intra- and postoperatively; estimated blood loss; ambient temperature and humidity; and core temperature at the time of surgery and hourly for 6 h. All blood and urine samples were repeated on the morning of the first postoperative day.

Blood loss was estimated by weighing swabs and adding to this an estimation of the volume of blood collected by surgical suction. For this, we assessed the degree of dilution by amniotic fluid by measuring the haemoglobin concentration of the suction bottle using a Hemocue® Hb 201^+ Analyzer (Hemocue AB, Ängelholm, Sweden) and comparing it to the haemoglobin measurement from the full blood count on the morning of surgery measured on a Sysmex XE2100 machine (Sysmex UK, Wymbush, UK), a technique based on previous work.[10] An estimate of time to regression of neuraxial anaesthesia was made by return of full motor power to the lower limbs as assessed by the Bromage score with a score of 1 indicating no motor block.[11]

A sample size of 60 was chosen to provide acceptable 95% confidence intervals, based on a variability seen in healthy individuals. Although not designed as a comparative study, subgroups and other factors were identified before starting the study that might have an effect on urine output, in order to generate hypotheses for possible testing in further observational studies. These were blood loss and fluid intake; use of non-steroidal anti-inflammatory drugs; and use of oxytocin. Comparisons between subgroups and between days 1 and 2 were made using unpaired or paired t tests after testing for normality using the Kolmogorov–Smirnov test, or Mann–Whitney rank sum test with $P < 0.05$ taken to denote statistical significance.

Results

Of 60 women initially recruited, we obtained full 24-h data for analysis from 52. Of the remaining 8 women, accurate data for the first 6 h were available in 7. The reasons for missing data related to difficulties complying fully with the fluid balance diary. One woman failed to provide any data adequate for analysis.

Mean (±SD) maternal age and BMI at booking were 34 (±5) years and 24 (±4) kg m^{-2} respectively. The median (range) for parity was 1 (0–4). Thirty-eight (64%) operations were for previous caesarean section, 13 (22%) for breech presentation and 8 (14%) for other reasons. Spinal anaesthesia was used in 39 (66%) women and combined spinal-epidural in 20 (34%). Heavy bupivacaine 0.5% w/v was used for spinal injection, in a dose of 2.0–2.6 (median 2.3) mL. Phenylephrine, in total doses of 50–1800 (median 550) μg was used in all women and in 5 this was supplemented by ephedrine in doses of 3–30 (median 9) mg. No women received general anaesthesia. Of 48 women with adequate data, median (range) time to full regression of neuraxial anaesthesia was 5 (2–10) h.

Cumulative urine output for all women is shown in Fig. 1. Oxytocin infusions were used prophylactically at obstetric request in 45 women (75%), at a standardised dose of 10 IU in 125 mL every hour for the first