International Journal of Obstetric Anesthesia (2015) **24**, 35–40
0959-289X/$ - see front matter
http://dx.doi.org/10.1016/j.ijoa.2014.08.004

ORIGINAL ARTICLE

ELSEVIER
www.obstetanesthesia.com

The effect of intra-abdominal pressure on sensory block level of single-shot spinal anesthesia for cesarean section: an observational study

T. Ozkan Seyhan,[a] M. Orhan-Sungur,[a] B. Basaran,[a] M. Savran Karadeniz[a]
F. Demircan[a] Z. Xu,[b] D.I. Sessler[b]
[a]*Istanbul University, Istanbul Faculty of Medicine, Department of Anesthesiology, Capa Clinics, Istanbul, Turkey*
[b]*Department of Outcomes Research, Cleveland Clinic, Cleveland, OH, USA*

ABSTRACT

Background: Increased intra-abdominal pressure in pregnancy is thought to affect intrathecal drug spread. However this assumption remains largely untested. The aim of this prospective study was to evaluate the association between intra-abdominal pressure and maximum sensory block level in parturients receiving spinal anesthesia for cesarean section.

Methods: Parturients having elective cesarean section with single-shot spinal anesthesia using hyperbaric bupivacaine 12.5 mg were included. Intra-abdominal pressure was measured via a bladder catheter after establishing a T4 sensory block and at the end of surgery in the supine position with 10° left lateral tilt. We recorded demographic data, descriptive characteristics of pregnancy, self-reported weight gain and weight of the newborn. As secondary outcomes, we evaluated onset of sensory block, maximum sensory block, motor block, number of hypotensive episodes, fluid and ephedrine requirements, time to first analgesic request, time to one-point recovery of motor block and side effects.

Results: The median value of the maximum sensory block level was T2 in 117 parturients. Median [interquartile range] pre-incision and postoperative intra-abdominal pressure were 13 [11–16] and 9 [6–10] mmHg respectively. No association was observed between maximum sensory block level and pre-incision intra-abdominal pressure ($P = 0.83$). Weight was associated with pre-incision intra-abdominal pressure with an estimated odds ratio of 1.04 per kg (99.4% CI: 1.00–1.08). There was a moderate correlation between pre-incision and postoperative intra-abdominal pressure with a Spearman correlation coefficient of 0.67 (99.5% CI: 0.5–0.79). There was no association between pre-incision intra-abdominal pressure and secondary outcomes.

Conclusions: In parturients, intra-abdominal pressure was not associated with spinal block spread, block onset time, recovery or side effects.

Keywords: Intra-abdominal pressure; Spinal anesthesia; Pregnancy

Introduction

Although the exact mechanism remains unknown, the association of pregnancy and decreased local anesthetic requirement is clear. James et al. demonstrated that more local anesthetic is required for cesarean section under combined spinal–epidural anesthesia in preterm compared with term patients.[1] Similarly, Jawan et al. showed increased cephalad spread in twin compared with singleton pregnancies.[2] Increased intrathecal local anesthetic spread and thus reduced local anesthetic requirement for a given number of dermatomes in pregnancy has been variously explained by mechanisms including biochemical,[3] hormonal[4] and anatomical changes.[5–7] An important anatomical explanation for increased intrathecal drug spread in pregnancy is that in the supine position the gravid uterus compresses the inferior vena cava (IVC), diverting blood into the vertebral venous system and displacing lumbosacral cerebrospinal fluid (CSF) in a cranial direction.[6,8–10]

Aside from directly compressing the IVC, the growing uterus during pregnancy leads to a global increase in intra-abdominal pressure (IAP);[11–13] a potential mechanism for increased intrathecal drug spread. The rationale behind this theory is twofold. First, increased global IAP itself may affect IVC pressure and thus contribute to venous engorgement. Indeed, increased IVC pressure due to increased IAP has been demonstrated in non-pregnant patients undergoing laparoscopy.[14] However, in pregnant patients, venous

Accepted August 2014
Correspondence to: Tulay Ozkan Seyhan, Istanbul University, Istanbul Faculty of Medicine, Department of Anesthesiology, Capa Clinics, 34093 Istanbul, Turkey.
E-mail address: tulay2000@gmail.com

engorgement is prominent in the supine but not the lateral position, which suggests direct compression of the IVC by the gravid uterus.[5] Second, an increase in IAP may affect the retroperitoneal area and may cause inward movement of soft tissue in the intervertebral foramina. Recent magnetic resonance imaging (MRI) studies in pregnant patients, although without IAP measurements, suggested the latter because they showed limited contact of engorged veins along the dural sac which may therefore not be responsible for compression of the dura.[15,16]

If elevated IAP contributes to high anesthetic spread during pregnancy, one would expect a relationship between IAP and maximum sensory block level. Therefore we conducted this prospective observational study primarily to evaluate the association between maximum sensory block level and IAP for a fixed dose of local anesthetic. Secondary aims were to investigate the association between IAP and onset of block at the T4 sensory level, motor block, postoperative IAP, block recovery, number of hypotensive episodes, ephedrine requirement, total amount of fluids and the incidence of nausea, vomiting and shivering.

Methods

With the approval of Clinical Research Ethics Committee of Istanbul Medical Faculty and informed consent, patients having single-shot spinal anesthesia for elective cesarean section in a single hospital were recruited for this prospective observational study between September 2012 and March 2013. Patients with preeclampsia, diseases leading to peripheral edema or ascites, contraindication to neuraxial anesthesia or known allergy to bupivacaine were excluded. We also excluded patients who had pathology requiring surgical intervention other than cesarean section, spinal puncture failure, or a need for additional intraoperative analgesia.

Following prehydration with Ringer's lactate solution 500 mL, spinal anesthesia was induced with hyperbaric bupivacaine 12.5 mg at room temperature via a 25-gauge Quincke-tip spinal needle in the sitting position at the L3–4 vertebral level using a midline approach by one of two investigators (TOS, MOS). Patients were then positioned in a 10° Trendelenburg position with 10° left-lateral tilt. The level of spinal anesthesia was assessed every 30 s using loss of cold sensation to ice. Onset of block at the T4 level was defined as the time interval between spinal injection and loss of cold sensation to ice at the T4 level. Thereafter, the operating table was returned to a horizontal position while maintaining left lateral tilt.

Sensory block assessment continued every 2 min until the block level remained unchanged for three consecutive assessments. The highest level achieved was defined as the maximum sensory block level. Motor block was assessed using a modified Bromage scale (0 = no motor block, 1 = hip flexion blocked, 2 = hip and knee flexion blocked, and 3 = hip, knee and ankle flexion blocked).

Systolic (SAP), diastolic (DAP) arterial pressure and heart rate (HR) were observed at baseline and at 2-min intervals after spinal injection for the first 15 min and at 5-min intervals throughout surgery. Hypotension was defined as a decrease in SAP of >30% below baseline or to <90 mmHg and was treated by increasing the rate of crystalloid infusion. If hypotension persisted for a second consecutive measurement, a bolus of intravenous ephedrine 5 mg was given. Bradycardia was defined as HR <60 beats/min and was treated with intravenous atropine 0.5 mg.

After establishing a T4 sensory level, a transurethral catheter was inserted to drain the bladder and measure pre-incision IAP in the supine position with 10° left lateral tilt as described by Chun et al.[12] Postoperative IAP was measured at the end of surgery with the parturient in the same position. Motor block was assessed after entry to the postoperative care unit every 15 min. Postoperatively, intravenous patient-controlled analgesia was started at the first analgesic request.

We recorded patients' age, weight, height, gestation, gravidity, parity, self-reported weight gain during pregnancy, number of fetuses, pre-incision and postoperative IAP, duration of surgery, block characteristics including onset of block at the T4 level, maximum sensory block level, motor block before the start of surgery, the interval between spinal injection and first analgesic request and one-point recovery of motor block. The number of hypotensive episodes, total ephedrine and fluid requirements, intraoperative nausea and vomiting and shivering were noted.

Statistical analysis

Sample size was calculated using the formula "104 + number of predictors" as suggested by Green to test the contribution of individual predictors on spinal block level.[17] Minimum acceptable sample size was 114; therefore we included 125 patients in the study. Data are presented as mean ± standard deviation (SD), median [interquartile range] or number (%). SAS version 9.3 (SAS Institute, Cary, NC, USA) was used for all analyses.

We assigned ordinal scores to dermatome levels (T4 = 0, T3 = 1, T2 = 2, T1 = 3, C8 = 4, C7 = 5, C6 = 6) and evaluated the association between maximum sensory block level and pre-incision IAP using ordered logistic regression. We included nine potential confounders as covariates: age, weight and height of patient, weight gain during pregnancy, gestational age, gravidity, parity, number of fetuses, and fetal weight. The odds ratio (OR) with 95% confidence interval (CI) for pre-incision IAP was calculated. The significance criterion for the covariates using a Bonferroni correction