EFFECT OF THE TRENDELENBERG POSITION ON SPINAL ANAESTHESIA WITH HYPERBARIC BUPIVACAINE

C. J. SINCLAIR, D. B. SCOTT AND H. H. EDSTROM

SUMMARY
In a double-blind study, the effect of the Trendelenberg position was compared with the supine, in 20 patients following intrathecal injection of 3 ml of 0.5% bupivacaine in 8% glucose. All patients had blocks suitable for abdominal surgery. Although the mean spread was greater in those patients tilted head-down, this was not statistically significant. The variation of the spread around the mean was greater in the head-down group, and blocks extended into the cervical region in two patients. There were no differences in motor block, duration or cardiovascular changes between the groups. It is concluded that the Trendelenberg position is not necessary to ensure spread of local anaesthetic solution into the mid-thoracic region for abdominal surgery.

Local anaesthetics for spinal anaesthesia are usually administered as hyperbaric solutions. One of the benefits claimed for hyperbaric solutions is that their spread can be controlled by posture. Standard texts (Moore, 1965; Lee and Atkinson, 1978) advocate the use of the Trendelenberg position to ensure spread of the hyperbaric local anaesthetic solution into the mid-thoracic region for abdominal surgery. This was thought necessary to ensure flow of the local anaesthetic solution down the lumbar curve into the thoracic concavity. The origin of this manoeuvre stems from work by Barker (1907), who studied the behaviour of hyperbaric solutions in a glass tube curved to reproduce the shape of the vertebral canal.

Recent work (Wildsmith et al., 1981), investigating the sitting and lateral positions, has suggested that posture is not as effective as was once thought. For example, sitting the patient upright during and for 2 min after the spinal injection resulted in a block only three to four segments lower than was achieved in the horizontal position. A lateral position maintained for 5 min resulted in a unilateral block, but this had become bilateral within 15 min of turning supine.

The present study was undertaken to determine the effect of a steep Trendelenberg position on the spread of blockade during spinal anaesthesia with 0.5% bupivacaine in 8% dextrose.

METHODS
Twenty female patients aged 30–69 yr, undergoing major gynaecological surgery for which spinal anaesthesia was thought appropriate, took part in this study. The nature of the study, which had approval from the local ethics committee, was explained and the patient's consent obtained. The 20 patients were allocated randomly to two groups of 10, one group to be tilted 15° head-down for 10 min immediately following injection of the local anaesthetic, the other to remain horizontal.

One hour before operation patients of less than 65 yr were given diamorphine 5 mg and atropine 0.6 mg and those older than 65 yr received diamorphine 2.5 mg and atropine 0.6 mg by i.m. injection. A standard mid-line lumbar puncture was performed using a 25-gauge needle in the L3–4 interspace. All lumbar punctures were performed with the patient in the right lateral position on a horizontal table. Three millilitre of 0.5% bupivacaine in 8% dextrose (sp. gr. 1.026 at 20°C) was injected, without barbotage, over a period of approximately 15 s. This dose was chosen after considerable experience with hyperbaric bupivacaine in lower abdominal surgery. The needle was withdrawn, the patient immediately turned supine and the table adjusted to a 15° head-down tilt or left in the horizontal according to the randomized list. Ten minutes later all patients were positioned supine and horizontal.

The cephalad spread of analgesia (loss of appreciation of pin-prick) and anaesthesia (inability to appreciate touch) and motor block in the legs were assessed at 12, 15, 20, 25 and 30 min by an investigator who had no knowledge of the position of the patients in the first 10 min following spinal injec-
tion. Motor block in the legs was graded on a 0–3 scale, 0 being no block, 1 = inability to raise the extended leg, 2 = inability to flex the knee and 3 = inability to flex the ankle. Arterial pressure and heart rate were measured every 2 min with a Dinamap 845 monitor (Applied Medical Research).

Thirty minutes after the spinal injection, seven patients undergoing lower abdominal surgery were anaesthetized with thiopentone followed by nitrous oxide in oxygen and 0.5% halothane, and the remaining 13 patients for vaginal surgery were deeply sedated with 0.8% chlormethiazole by continuous i.v. infusion. During surgery, any requirement for further analgesia or muscle relaxation was provided by increasing the concentration of halothane or the use of gallamine 40 mg and their use was noted.

Following recovery of consciousness, analgesia, anaesthesia and motor block were assessed every 15 min until regression of analgesia to L5, or full restoration of motor power. Duration of sensory block was assessed as the last time analgesia could be detected at the T12 and L5 dermatomes. It was possible to assess 16 patients (eight in each group) before the block had regressed to T12, and 18 patients (nine in each group) before regression to L5. In the two remaining patients operating time was greater than 4 h and there was no sensory deficit on recovery of consciousness. Similarly, recovery from motor block could only be assessed in 18 patients.

The results were analysed using Student's t test, P<0.05 being taken to indicate a significant difference.

RESULTS

There were no statistical differences in mean age, weight and height between the two groups (table I). In the head-down group, six patients underwent vaginal surgery and four had lower abdominal operations, compared with seven and three respectively in the horizontal group.

Sensory spread (figs 1 and 2). The mean spread of analgesia was greater in the head-down group although this difference was not statistically significant. There was a wider range in the head-down group (C4–T4) compared with the horizontal group (T2–T6), and two patients in the head-down group

<table>
<thead>
<tr>
<th>TABLE I.</th>
<th>Mean (± SEM) age, weight and height in the two groups</th>
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<tbody>
<tr>
<td></td>
<td>Horizontal</td>
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<tr>
<td>Age (yr)</td>
<td>50.6 ± 3.7</td>
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<tr>
<td>Weight (kg)</td>
<td>63.8 ± 2.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.5 ± 1.9</td>
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</tbody>
</table>

FIG. 1. Mean levels (± SEM) of anaesthesia and analgesia following subarachnoid injection in the two groups: ■ = analgesia and □ = anaesthesia in the head-down group; ● = analgesia and ○ = anaesthesia in the horizontal group.

FIG. 2. Cephalad spread of analgesia, 30 min after subarachnoid injection, in the 10 patients in each group.
had spread into the cervical segments (C4 and C8).

Anaesthesia was also higher in the head-down group, although again this difference was not statistically significant. Analgesia to pin-prick was generally three to four spinal segments higher than anaesthesia.

**Motor block.** This was complete (grade 3) in eight patients in the horizontal group and nine in the head-down group. There was no difference in speed of onset.

**Cardiovascular changes** (table II). Arterial systolic pressure decreased by a mean of approximately 30 mm Hg in both groups over the first 30 min following spinal injection. There was no significant difference between the groups. The lowest systolic pressure recorded was 77 mm Hg. There was no correlation between spread of the block and decrease in arterial pressure.

Table II. Cardiovascular changes. Mean (± SEM) arterial systolic and diastolic pressures before and after (mean lowest values) spinal block in the two groups. Mean (± SEM) heart rates before and after (mean most different from before block values) spinal block in the two groups

<table>
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<tr>
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<tr>
<td>Systolic pressure (mm Hg)</td>
<td></td>
<td></td>
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<tr>
<td>Before block</td>
<td>132.4±2.8</td>
<td>131.1±5.2</td>
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<tr>
<td>Lowest value</td>
<td>98.8±4.3</td>
<td>101.7±3.4</td>
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<tr>
<td>Diastolic pressure (mm Hg)</td>
<td></td>
<td></td>
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<tr>
<td>Before block</td>
<td>74.7±3.8</td>
<td>79.4±3.8</td>
</tr>
<tr>
<td>Lowest value</td>
<td>53.9±3.4</td>
<td>56.4±3.1</td>
</tr>
<tr>
<td>Heart rate (beat min⁻¹)</td>
<td></td>
<td></td>
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<tr>
<td>Before block</td>
<td>92.3±3.3</td>
<td>87.2±5.7</td>
</tr>
<tr>
<td>After block</td>
<td>81.7±6.4</td>
<td>78.5±6.1</td>
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Mean heart rates decreased by approximately 10 beat min⁻¹, but individual percentage changes ranged from −45% to +45%. The slowest recorded heart rate during the first 30 min following spinal injection was 59 beat min⁻¹.

**Supplementary anaesthesia.** Six of the seven patients undergoing abdominal surgery required, approximately 1.5–2 h after spinal injection, an increase of halothane to 1% and a small dose of gallamine to ensure satisfactory operating conditions.

**Duration** (table III). There were no significant differences between the groups. Duration of analgesia in the T12 dermatome was approximately 2.5 h, and in the L5 dermatome approximately 3–3.5 h. Motor power in the legs returned to normal after approximately 2.5–3 h. There was no prolongation of motor block after return of normal sensation in any patient.

Table III. Mean (± SEM) duration of analgesia at the T12 and L5 dermatomes in the two groups

<table>
<thead>
<tr>
<th></th>
<th>Horizontal</th>
<th>Head-down</th>
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<tr>
<td>Duration (min) at T12</td>
<td>145.3±7.2</td>
<td>152.8±7.2</td>
</tr>
<tr>
<td>Duration (min) at L5</td>
<td>193.3±10.4</td>
<td>201.7±11.5</td>
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**DISCUSSION**

Although the use of the Trendelenberg position increased the mean spread of analgesia, this was only of the order of one to two spinal segments, and was attributable to the fact that two patients had blocks extending into the cervical region. The other eight patients who were tilted had blocks comparable in height to the 10 who remained horizontal. We feel, therefore, that the use of the Trendelenberg position does not guarantee a higher spread of anaesthesia in an individual patient, but can occasionally cause unduly high spread.

A 15° head-down tilt does not sound excessive, but was in fact the maximum that our tilting trolley would allow. Any further degree of Trendelenberg would undoubtedly have been most uncomfortable for the conscious patient. In a previous study (Wildsmith et al., 1981) it was seen that the sitting position (90° head-up) only reduced the height of block by three to four spinal segments and the results of the present study are therefore not unexpected.

Bupivacaine 0.5% in 8% glucose was chosen for this study as we were interested in its potential as a new agent for spinal anaesthesia. We were able to confirm that this hyperbaric solution produces a
satisfactory block for abdominal surgery, which is
not always the case with the isobaric solution
(Chambers, Edström and Scott, 1981). Although six
of the seven patients undergoing abdominal opera-
tions required supplementary anaesthesia before the
end of surgery, it must be remembered that we were
allowing 30 min to assess the spinal block before
surgery, which could have started much earlier in
these patients. Hyperbaric bupivacaine, although
achieving a high level of spread, is inclined to wear
off quite rapidly compared with the isobaric solu-
tions. A shorter duration is only to be expected with
a wide spread, as less anaesthetic will be available for
each nerve blocked. The average duration of the
block before regression to T10 was 133 ± 5.9 min in
those patients in whom it could be measured. This
fits with the clinical observation that supplementation
was required 90–120 min after the spinal injec-
tion.

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EFFET DE LA POSITION DE TRENDELENBERG SUR
LA RACHIANESTHESIE A LA BUPIVACAINE
HYPERBARE

RESUME
Nous avons etudie, dans un essai en double aveugle, l'effet de la
position de Trendelenberg chez 20 patients, apres l'injection
intrathecale de 3 ml de bupivacaine a 0,5% dans du glucose a 8%.
Tous les patients avaient des blocs compatibles avec la chirurgie
abdominale. Bien que l'extension moyenne soit plus grande chez
les patients bascules tete en bas, ceci n'etait pas statistiquement
significatif. Les ecarts par rapport a la valeur moyenne de l'exten-
sion etaient plus grands dans le groupe des patients bascules, et
les blocs remontaient dans la region cervicale chez deux patients.
Il n'y avait pas de differences de bloc moteur, de duree d'anesth-
these ou de modifications hemodynamiques entre les deux
groupes. Nous en concluons que la position de Trendelenberg
n'est pas necessaire pour assurer la diffusion de la solution
anesthesique locale jusqu'a la region thoracique moyenne en
chirurgie abdominale.

DIE WIRKUNG DER TRENDELENBERG-LAGERUNG
AUF DIE SPINALANÄSTHESIE MIT HYPERBAREM
BUPIVACAIND

ZUSAMMENFASSUNG
In einer Doppelblindstudie untersuchten wir bei 20 Patienten die
Wirkung der Trendelenberg-Lagerung auf die intrathekale In-
jektion von 3 ml 0,5% Bupivacain in 5% Glucose. Alle Patienten
hatten eine Blockade, die für die Bauchchirurgie ausreichene. Die
mittlere Blockadeausbreitung war bei den Patienten mit Kopf-
tieflage gerinig, aber nicht signifikant hoher. Die Abweichung
von der mittleren Blockadeausbreitung war in der Gruppe mit
Kopftieflage grösser und bei zwei Patienten erreichte das Anas-
thesieniveau das Zervikalregion. Keinen Unterschied gab es bei
der Blockade der Motorik, der Analgesiezeit und der Kreislauf-
wicklung zwischen den beiden Gruppen. Wir schließen daraus,
dass die Trendelenberg-Lagerung nicht notwendig ist um die
Ausbreitung des Lokalanästhetikums in die mittlere Thorakal-
region, wie sie für die Bauchregion notwendig ist, zu gewähr-
leisten.

EFECTO DE LA POSICION DE TRENDELENBERG EN
LA ANESTESIA DE LA COLUMNA VERTEBRAL
MEDIANTE BUPIVACAINA HIPERBARICA

SUMARIO
Se estudió en veinte paciente, en un estudio de doble anonimato,
el efecto de la posición de Trendelenberg, a raíz de una inyección
intratecal de 3 ml de 0,5% de bupivacaina en glucosa al 8%. Todos
los pacientes sufrieron bloqueos adecuados para la intervencional
abdominal. Aunque la dispersión media fue superior en aquellos
pacientes inclinados con la cabeza hacia abajo, esto no fue estadis-
ticamente significativo. La variación de la dispersión alrededor de
la media fue superior en el grupo de cabeza a bajo, extendiéndose
bloqueos en la región cervical de dos de los pacientes. No hubo
diferencias en el bloqueo motriz ni en la duración, ni tampoco
cambio cardiovascular entre los diversos grupos. Se concluye
que la posición de Trendelenberg no es necesaria para asegurar la
dispersión de la solución anestésica local en la región torácica
media para fines de intervención quirúrgica abdominal.