Assessing blocks after spinal anaesthesia for elective caesarean section: how different questions affect findings from the same stimulus

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ABSTRACT

Background: A block to touch to T5 is widely used to indicate an adequate level of block for caesarean section with spinal anaesthesia. However, two studies using a “block to light touch” to T5 as their end-point, had a high requirement for intraoperative analgesia and their results cast doubt on the adequacy of a block to touch to T5. On enquiry, these two papers did not assess complete block to touch, but asked mothers when the touch sensation “was the same as” a control stimulus. The difference between these two assessment methods is unknown. The current study presents prospectively collected sensory block data which included both block to touch and the level when touch was the same as a control stimulus.

Methods: The levels of block were assessed using a Neurotip®. The mother was asked four questions to assess the block: first touch level, first sharp level, touch same as control and sharp same as control.

Results: The first touch level was a median of two dermatomes lower than the touch same as a control level [IQR 0–3, range 0–6]. Block level assessment methods using first sharp and touch same as control were equivalent.

Conclusion: When describing a sensory block, not only is it necessary to indicate the exact stimulus used, but it is important to define the actual question asked of the patient. Clinically, block assessment using the first sharp level and touch same as control are equivalent.

Keywords: Neurotip®; Spinal anaesthesia; Sensory block assessment; Caesarean section

Introduction

In 1965 Bromage described detailed tests for assessing lower limb motor function during epidural analgesia.1 A year later Hollmén described detailed sensory tests for touch and pinprick sensations in relation to the assessment of brachial plexus blocks.2 Today, motor block in association with epidural or spinal anaesthesia is frequently described in terms of the Bromage score;1 the accompanying sensory block is generally poorly described. The majority of publications on neuraxial anaesthesia for caesarean section state the modality used to assess the level of block (e.g. cold, pinprick or touch), but the actual description of how this modality was used is either lacking or is so imprecise that the reader does not know what has been assessed. A study may state simply that sharp pinprick was used to assess the block, but there are four possible end points: (1) total loss of all sensation to the pin; (2) the pin is recognised as a touch sensation but is not recognised as being sharp; (3) the pin is recognised as being sharp but is less sharp than normal; or (4) the pinprick feels normal. In addition, there is also a variable, and at times a very wide number of dermatomes difference in block levels assessed by these four end points.3–7

The current observational study was prompted by the results of two up-down minimum local anaesthetic concentration (MLAC) studies,8,9 which described their end-point as “a block to light touch to T5.” Despite achieving this level of block, both studies reported a relatively high requirement for intraoperative analgesia: 17/1868 and 18/80.9 These high proportions of women requiring analgesic supplements are very different from the experience in our own unit where “a block to touch to T5” is rarely associated with a need for additional intraoperative analgesia. Subsequent communication with one of the authors (GR Lyons, personal communication, March 2006) revealed that the block level end-point was when the patient considered that the touch sensation was the same as a control stimulus on the forehead. This is different from the total
loss-of-touch sensation (Hollmén grade 3)² utilised in our unit and, in addition, the “touch same as a control” stimulus level is not a grade used in the Hollmén scale. Since the dermatomal difference between levels of block to touch as assessed by these two methods (“touch same as a control” versus “total loss-of-touch sensation”) was unknown, we modified our routine sensory assessment to include the level of block when touch was the same as a control stimulus.

Methods

Following approval from the Hull and East Yorkshire Hospitals Local Research Committee, as part of her standard clinical practice, one of the authors (NMN) kept a detailed contemporaneous record of the levels of Hollmén block and the level at which touch sensation was the same as a control stimulus. The study population were American Society of Anesthesiologists physical status class I or II women scheduled for elective caesarean section under spinal anaesthesia, who were not involved in other research, and who gave informed consent to participate. Women were seen on the morning of surgery when a 5-cm wide strip of low allergenic tape (Micropore, 3M Health Care Ltd, Leicestershire, UK) was applied to the midline, from sternal notch to umbilicus. Dermatomal levels from T3 to T10 were estimated and marked on the tape. A spinal anaesthetic using 0.5% w/v hyperbaric bupivacaine 2.5 mL with diamorphine 0.3 mg (total volume 2.8 mL), was administered at what was estimated to be the L3–4 interspace. Sharp sensation was assessed using the round-tipped metal pin of the Neurotip® where the sharp pinprick sensation from the round tipped metal pin of the Neurotip® was felt to be the same as a control stimulus: the question asked of the woman was, “Tell me when the sensation is the same as this” (the round tipped metal pin of the Neurotip® pressed against the skin of the upper outer arm) (Hollmén grade 0).²

Since sensory testing was performed from caudal to cephal (i.e. from blocked to unblocked dermatomes) these questions identify the first unblocked dermatome. Data presented in this paper are one dermatome lower, to represent the dermatomes blocked to that stimulus. A clinically significant difference in the assessed block levels was taken to be more than one dermatome.

Statistical analysis

For statistical analysis, spinal segments were numbered from S5 to C2 as 1 to 29; these were treated as interval data. Based on our previous studies, to have a 90% chance of detecting a difference of two dermatomes (SD 2.6) at the 5% significance level, data from 40 women were required. Statistical analysis was performed using the software IBM SPSS Statistics version 19.0.0 (IBM Corporation, Armonk, NY, USA). Because of the rapidly changing block levels at 2 min these data were not used in statistical analysis. The Friedman test was used to assess differences in the levels assessed by the four questions and a post hoc Wilcoxon signed-rank test for pairs of related samples was used to investigate individual paired differences. In the post hoc tests, the Bonferroni correction was used and since six paired tests were performed, the significance value was \( P < 0.0083 \). The two one-sided t-tests (TOST) method was used to assess the equivalence of two of the sensory tests. Equivalence was defined as a dermatomal difference of <0.5 dermatomes.

Results

Complete data from 38 women were available for analysis. Fig. 1 illustrates the onset of the spinal block for each of the four categories of block. The Friedman test indicated that there was a statistically significant difference between the levels of block defined by each of the four assessment methods for the entire data set \( (P < 0.0001) \). Post hoc paired tests revealed that there was a statistically significant difference between all the individual comparisons (Fig. 2).

Despite the FS-TSA difference being statistically significant, the actual dermatomal differences were minimal (95% CI for the differences between FS and TSA were −0.02 to −0.26 dermatomes) and a TOST test
for equivalence was performed. This indicated that the dermatomal difference between these two methods of testing was <0.5 dermatomes signifying that clinically, the two methods can be considered as equivalent. No patient required any supplementary analgesia.

Discussion

The results of this study reveal the previously described variable and statistically significant difference between the levels of block assessed by touch and sharp according to the Hollmén grades. The data also demonstrate that there is a variable and statistically significant difference between block levels assessed by the first sensation of touch and the level assessed using the touch the same as a control stimulus.

A block of touch up to and including T5 has been associated with a very low requirement for intraoperative supplementary analgesia in our unit. Thus, the relatively high incidences of pain (17/186 and 18/80) reported in two studies where the level of block aimed for was described as “a block to light touch to T5” was surprising. Subsequent communication with one of the authors revealed that the actual sensation assessed was when the sensation of touch at T5 was the same as a control stimulus on the forehead. The current results show that assessment using “First Touch” is two dermatomes lower than that with “Touch Same as Control Stimulus”. In addition, in a proportion of cases (10% of assessments, and 10% of patients at 15–20 min), the difference in block levels was >2 [range 3–6] dermatomes. Thus, when comparing the levels of block in the two MLAC studies with the levels of block from this institution, on average, the levels of complete loss-of-touch sensation in the MLAC studies would be T7 or lower in 10% of cases, and not T5. This lower level of two (or more) dermatomes of complete block to touch would provide a logical explanation for the high proportion of patients experiencing pain in those studies.

Another difference between those two MLAC studies and previous studies from this unit is that those two studies used the forehead as the site for the control stimulus, whereas the upper arm was used in the current study and previous studies. Since, in Hull, we had never used the forehead as the site for a control stimulus before, we compared touch stimuli on the forehead and abdomen in few volunteers. In these non-anaesthetised volunteers, precise comparison of the two touch stimuli proved elusive: the volunteers found it very difficult to equate our typical firm Neurotip touch stimulus on the forehead with the same stimulus on the abdomen. All found the forehead stimulus to be much more intense and different in quality from the abdominal stimulus. This difference in intensity on the forehead probably relates to the relative lack of subcutaneous tissue between the skin and the bone. How this difference in intensity and quality of the forehead stimulus might translate into clinical use when a patient is asked to compare it with an abdominal skin stimulus during neuraxial anaesthesia is unknown. It is known that using different stimuli to create the touch sensation often gives quite different levels of block and this, it is proposed, may be related to the intensity of the sensations produced by the different stimuli at the same site. It may be that using the same stimulus at different anatomical sites, where one site produces a more intense
stimulus than the other, will also be a confounding factor leading to different levels of block being identified.

Although the TOST analysis confirmed that FS and TSA assessments were equivalent within 0.5 dermatomes, and for the vast majority of assessments there was no difference in the levels of block assessed by these two methods of testing, there were nine outlier values ranging from FS being four dermatomes higher to five dermatomes lower than TSA. Similar unexplained wide individual dermatomal differences in block levels have been noted before.\textsuperscript{10,12,13} The equivalance of these testing methods may be useful as it allows the subjective “touch same as,” to be replaced by a binary decision, sharp or not sharp. As the above discussion illustrates, a testing method which relies on a patient comparing two stimuli on different parts of the body is subjective and may be affected by the anatomy of the control site. Simply asking a patient when something touches them, or when the pin first feels sharp is probably as near a simple binary response as one can get.

The study has potential limitations in that the target number of patients was not achieved, the assessments were performed by one investigator, the assessments were not randomised, and the level of block could change between assessments. As regards the latter, the assessments take a matter of seconds to complete so changes in block levels during this period would be minimal (Fig. 1), especially as the 2 min assessments were not used. With only one unblinded assessor bias is a possibility but this risk is low. Bias is more likely when there is some a-priori assumption, the assessor has an opinion about this assumption, and the assessor has to make a subjective decision. None of these applied in this study: we did not have any prior assumptions or opinions as there had been no previous similar investigation; the assessor was not making a subjective assessment but simply recording a woman’s responses and comparing these to the dermatomes already marked out on the tape. Although the original number of patients to be included was 40, this had been rounded up to allow for some data loss. Based on the original power calculation data, 38 patients still results in a power of over 90\% and, as the data demonstrate, obtaining high level of statistical significance was not an issue.

The findings of this study reinforce the plea made by others as regards the importance of giving a very clear description of how a block is assessed when publishing study results.\textsuperscript{10,11} Without a clear and unambiguous description of the testing methods, comparing outcomes in different studies is difficult, if not impossible, and may lead the reader to draw incorrect conclusions on the efficacy of a particular method of testing block height.\textsuperscript{14} Like motor block, where the Bromage score identifies what has been tested, perhaps the time has come for sensory assessments to be described in terms of the Hollmén grades.\textsuperscript{2}

**Disclosure**

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**References**