Spinal anaesthesia with lidocaine 2% for Caesarean section

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Spinal anaesthesia with 2, 2.5 or 3 ml of glucose-free lidocaine 2% was studied in 50 patients undergoing Caesarean section. Onset time, cephalad spread of analgesia, quality of analgesia, muscle relaxation, the cardiovascular effects and duration of analgesia and motor block were assessed. Reliable anaesthesia was provided with 2.5 and 3 ml while 2 ml of 2% lidocaine was insufficient. Onset time varied between 5.5 to 6 min and maximum cephalad spread was achieved in 10–15 min. The mean maximum extent of sensory analgesia was higher after 2.5 ml ($T_{4,1}$) and 3 ml ($T_{3,6}$) than after 2 ml (T_7) ($P < 0.001$). Complete motor block was achieved in all the patients. The mean duration of sensory block was 123 ± 6.23 min (2 ml) to 126 ± 7.53 min (2.5 and 3 ml). The mean duration of motor block in 2.5 and 3 ml groups was higher ($P < 0.001$) than in the 2 ml group and was correlated with the dose of lidocaine ($P < 0.05$). Hypotension (SBP < 100 mmHg) was noted in 10% ($n = 5$) of patients in whom the cephalad spread of analgesia was also higher. All the neonates had an apgar score of 7 or more at 1 min. These results suggest that 2.5 to 3 ml of 2% lidocaine provides satisfactory anaesthesia for Caesarean section.

Ce travail évalue la qualité de la rachianesthésie réalisée avec de la lidocaïne 2% sans glucose chez 50 patientes opérées pour césarienne. La vitesse d'installation, la progression céphalique, la qualité de l'analgésie, la relaxation musculaire, les effets cardiovasculaires et la durée de l'analgésie et du block moteur sont analysés. Une anesthésie efficace est obtenue avec 2,5 et 3 ml contrairement aux 2 ml de lidocaïne 2%. La vitesse d'installation varie entre 5,5 et 6 min et la progression maximale est complétée après 10–15 minutes. L'extension maximale moyenne de l'analgésie est plus grande avec 2,5 ml ($T_{4,1}$) et 3 ml ($T_{s,6}$) qu'après 2 ml (T_7) ($P < 0,001$). On a obtenue un block moteur complet chez toutes les patientes. La durée moyenne du block sensitif est de 123 ± 6,23 min (2ml) à 126 ± 7,53 min (2,5 et 3 ml). La durée moyenne du block moteur dans les groupes ayant reçu 2,5 et 3 ml est plus longue ($P < 0.001$) que chez celles qui ont reçu 2 ml avec une corrélation positive pour la posologie ($P < 0,05$). On a relevé de l'hypotension (PAS < 100 mHg) chez 10% ($n = 5$) des patientes chez lesquelles la progression céphalique était la plus élevée. Tous les nouveaux-nés cotaient 7 ou plus sur l'échelle d'Apgar à la première minute. Ces résultats suggèrent que 2,5 à 3 ml de lidocaïne 2% procurent une anesthésie satisfaisante pour la césarienne.

Key words
ANAESTHESIA: obstetric, Caesarean section;
ANAESTHETIC TECHNIQUES: spinal;
ANAESTHETICS, LOCAL: lidocaine.

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An increasing number of parturients wish to be awake during Caesarean section[1] and opt for regional rather than general analgesia. Spinal block is a simple technique which requires a small dose of local anaesthetic to provide surgical anaesthesia[1,2] with rapid, intense and reliable block without missed segments,[1,3] greater muscle relaxation[1] and minimal risk of drug toxicity to the mother as well as to the fetus.[3] For these reasons it has been proposed as the anaesthetic method of choice for urgent Caesarean delivery.[4]

Lidocaine 5% with 7.5% glucose is a short-lasting drug used to produce spinal anaesthesia for Caesarean section but one drawback is that the spread of analgesia is dependent on posture because of its hyperbaricity.[5,6] Bupivacaine, 0.5% isobaric solution, has been used,[7,11] but its use in Caesarean section is controversial,[3,7-11] because of its long duration of action[3] and unpredictable level of block.[9,10] A glucose-free solution of lidocaine 5% is not available. Further, the reason for using 5% lidocaine for spinal anaesthesia is unclear.[12] Glucose-free isobaric lidocaine 2% solution has been used successfully in elderly patients for transuretheral surgery.[12-14]

So far, glucose-free 2% lidocaine has not been administered intrathecally for Caesarean section. Moreover, the requirement of intrathecal local anaesthetic in pregnancy

is reduced.[3,15] Hence we decided to administer three different volumes of lidocaine 2% in a glucose and preservative-free solution (Xylocard® Astra) to determine the optimum dose of lidocaine required and to compare the anaesthetic properties.

Methods

Fifty healthy (ASA I), unpremedicated patients, scheduled for elective Caesarean section at term, who wished to be awake during the procedure were studied after obtaining their informed consent. Patients with medical conditions such as diabetes, pregnancy-induced hypertension, obesity and cardiac disease were excluded from the study.

The patients were randomly assigned to receive either 2 ml, 2.5 ml or 3 ml of glucose and preservative-free lidocaine 2% at room temperature (density at 37° C = 1.0003 $g \cdot ml^{-1}$, baricity at 37° C = 1.0000, pH = 4.7). Baseline blood pressure and heart rate were recorded. All the patients were prehydrated with 1500 ml Ringer's lactate solution *iv* warmed to 37° C. The fluids were administered over 15–20 min.

With the patient in the sitting position, lumbar puncture was performed at the L_3–L_4 inter-space using a 23-gauge needle with its bevel facing laterally. Once free flow of cerebrospinal fluid was obtained, lidocaine was injected without barbotage at a rate of 1 ml per five seconds. The solution injected in each patient was determined from a random list and was known only to the anaesthetist performing the block. Immediately after the injection, the patients were placed in the supine position with the table tilted 30° towards the left. A further 500 ml Ringer's solution was infused during the following 30 min.

Blood pressure, heart rate, cephalad spread of sensory blockade and the degree of motor blockade of the lower limbs were recorded at five-minute intervals for the first 30 min and then every 15 min for three hours or until the block wore off, whichever was earlier. All assessments were made by third author, who was blind to the solution injected.

Surgical analgesia was assessed by the surgeon, the anaesthetist and the patient, and was graded as excellent, good, fair or poor. Analgesia was considered excellent when the patient did not require any supplementary drug, good when an analgesic or sedative was required, fair when more than one injection of analgesic or sedative was required and poor when the discomfort was so intense that general anaesthesia had to be administered. Relaxation was assessed by the surgeon as good, fair or poor. The surgeon and the patient were also unaware of the volume of lidocaine used for block.

The level of sensory blockade was assessed using a blunt needle and was tested along the anterior axillary line on the trunks, legs and perineum. Analgesia was defined as the loss of sensation to pin prick and anaesthesia as the loss of sensation of touch. Motor block of the lower limb was assessed using the Bromage scale:[16] 0 = no paralysis (full flexion of the knees and feet); 1 = inability to raise extended leg (just able to move knees); 2 = inability to flex knees (able to move feet only); 3 = inability to flex ankle joint (unable to move the knees or feet).

Hypotension, defined as a systolic arterial pressure of <100 mmHg irrespective of the baseline pre-induction arterial pressure, or a decrease in systolic arterial pressure of >30% of the baseline value, was treated by increments of mephentermine 5 mg *iv*.

All the patients breathed O_2 40% through a Ventimask, until the baby was delivered. Neonatal Apgar scores were taken by the attending paediatrician. Verbal contact with the patients was maintained at all times, while they underwent surgery. Requirement of supplementary drugs during surgery was noted. At 24 and 72 hr, patients were assessed for maternal satisfaction.

Statistical analysis was performed using an analysis of variance (ANOVA) for parametric data and the Mann Whitney test for non-parametric ordinal data. A chi-square test for non-parametric categorical data was used. An association between two variables was ascertained by calculating coefficient of correlation. $P < 0.05$ was regarded as statistically significant.

Results

Originally we planned to study 20 patients in each group but because of poor results with 2 ml we stopped further investigation after ten patients in this group. The 50 patients studied were divided into three groups which were similar with respect to age, weight, height, gestational age, preoperative blood pressure and pulse rate (Table I).

Onset and spread of analgesia (Figure 1)

At 5 min, analgesia was detectable in the thoracic dermatomes in all patients. The time for maximum cephalad spread of analgesia was 10–15 min (Table II). There was no difference among the groups in onset time but the mean maximum cephalad level of analgesia achieved was higher ($P < 0.001$) in the 2.5 and 3 ml groups during the onset and spread than in the 2 ml group. The 2.5 and 3 ml groups were comparable. There was a strong correlation ($P < 0.01$) between the dose of the local anaesthetic injected and the highest level of analgesia achieved ($r = 0.6507$, $n = 50$; $r = 0.7277$, $n = 30$, 2 and 2.5 ml groups; $r = 0.7531$, $n = 30$, 2 and 3 ml groups).

Regression and duration of analgesia (Figure 2)

At 60 min, the mean segmental level of analgesia had begun to regress. A 2–3 segment regression was noted after 75–90 min. The total time for complete regression of

TABLE I Patient data (± SD)

	2 ml	*2.5 ml*	*3 ml*
n	*10*	*20*	*20*
Age (yr)	27.5 ± 3.8	29.3 ± 4.2	28.7 ± 4.5
Weight (kg)	65.1 ± 11.9	67.6 ± 12.8	66.4 ± 13.6
Height (cm)	158.3 ± 14.7	160.7 ± 15.2	159.8 ± 14.6
Gestational age (wk)	38.9 ± 0.41	39.1 ± 0.26	39.4 ± 0.30
Duration of surgery (min)	66.8 ± 10.2	58.3 ± 4.78	57.5 ± 5.0
Basal systolic blood pressure (mmHg)	128.0 ± 15.7	125.2 ± 14.8	127.5 ± 15.1
Basal heart rate (beats · min^{-1})	75.6 ± 7.8	76.9 ± 8.2	74.3 ± 9.7

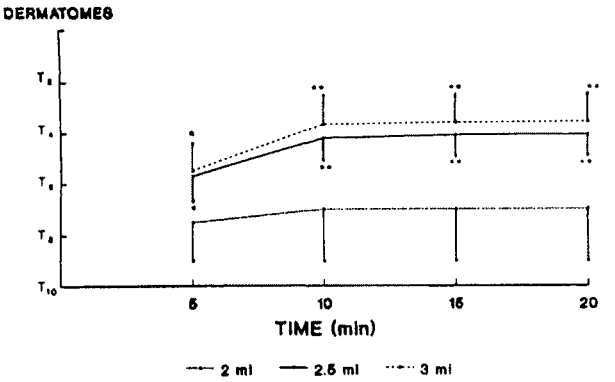

FIGURE 1 Onset and maximum cephalad spread of analgesia. *$P < 0.01$, **$P < 0.001$ Groups II and III compared with Group I (Mann Whitney Test).

TABLE II Mean thoracic dermatomal level (± SD) after spinal anaesthesia (min)

	Onset and spread			
	5	*10*	*15*	*20*
2 ml	7.5 ± 1.5	7.0 ± 2	7.0 ± 2	7.0 ± 2
2.5 ml	5.7 ± 0.92*	4.2 ± 0.89†	4.1 ± 0.85†	4.1 ± 0.85†
3 ml	5.5 ± 1.10*	3.65 ± 1.13†	3.6 ± 1.09†	3.6 ± 1.09†

*$P < 0.01$ compared with 2 ml group.
†$P < 0.001$ compared with 2 ml group.

analgesia varied from 120 min to 150 min. The mean time for complete regression of analgesia was 123 ± 6.23 min in the 2 ml group and 126 ± 7.53 min in the 2.5 and 3 ml groups. At 135 min after the injection of local anaesthetic, complete regression had occurred in eight (80%) patients in the 2 ml group and 12 (60%) patients each in the 2.5 and 3 ml groups. Complete regression of analgesia had occurred in all the patients at 150 min. There was no correlation between the dose of local anaesthetic and the duration of analgesia.

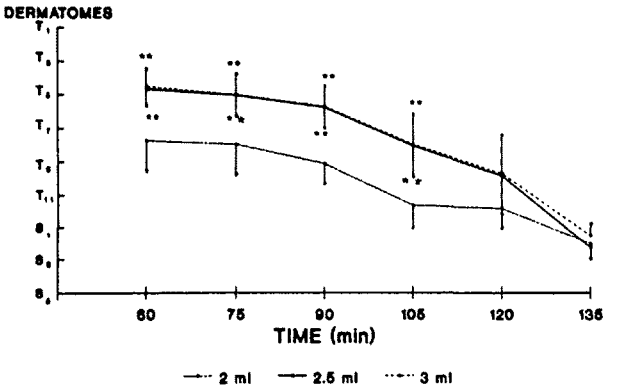

FIGURE 2 Regression and duration of analgesia. **$P < 0.001$ Groups II and III compared with Group I (Mann Whitney Test).

TABLE III Assessment of surgical analgesia by anaesthetist, surgeon and patient

	2 ml (n = 10)	*2.5 ml (n = 20)*	*3 ml (n = 20)*
Excellent	1	11	13
Good	2	9	7
Fair	3	0	0
Poor	4	0	0

Motor block

Onset time for complete motor block (grade 3) was rapid requiring 5.5 to 6 min and was 5.5 ± 1.53 min in the 3 ml group and 6 ± 2.10 in the 2 ml group ($P < 0.05$).

Complete motor block was obtained in all patients.

Longer duration of block was found in the 2.5 and 3 ml groups ($P < 0.01$) than in the 2 ml group. A correlation was found between the dose of lidocaine injected and the total duration of grade I motor block only ($n = 50$, $r = 0.2912$, $P < 0.05$) but not for grade 2 and 3 blocks.

Quality of analgesia and muscle relaxation

Assessments of surgical analgesia by the patient, anaesthetist and surgeon were similar and, therefore, the combined assessment is shown in Table III. All patients in the 2.5 ml and 3 ml groups but only three (30%) patients in the 2 ml group had good to excellent analgesia ($P < 0.01$). Four patients in the 2 ml group, but none in 2.5 ml or 3 ml groups, required supplementation with general anaesthesia.

Muscle relaxation was graded as good or fair in all patients in the 2.5 ml and 3 ml groups but only in 50% of patients in 2 ml group ($P < 0.01$, Table IV).

TABLE IV Assessment of muscle relaxation by surgeon

	2 ml (n = 10)	*2.5 ml (n = 20)*	*3 ml (n = 20)*
Good	2 (20)	18 (90)	19 (95)
Fair	3 (30)	2 (10)	1 (5)
Poor	5 (50)	0	0

Numbers in parenthesis are percent values.

Cardiovascular effects

Mean systolic blood pressure and heart rate were comparable among the groups throughout the period of study. A decrease in systolic blood pressure of more than 30% after subarachnoid block was noted in three patients in the 3 ml group and in two patients in the 2.5 ml group. This responded to increments of mephentermine 5 mg *iv*. The mean maximum cephalad spread of analgesia was higher ($P < 0.001$) in the patients who had a decrease in blood pressure. No patient in any group had clinically important bradycardia or tachycardia.

Side effects and maternal satisfaction

Nausea and/or vomiting were noted in two patients each in the 2.5 and 3 ml groups. These patients had considerable decreases in blood pressure. Three patients (one in each group) developed headache which resolved with conservative treatment. Four patients in the 2 ml group and all in the 2.5 and 3 ml groups were satisfied with the anaesthesia.

Neonatal assessment

All neonates had Apgar scores of 7 or more at one minute and 9 or 10 at five minutes. The neonatal Apgar scores were comparable in all groups.

Discussion

Isobaric solutions are less influenced by posture than are hyperbaric solutions.[5,6] The use of an isobaric solution allows the patient to be positioned in a comfortable sitting position for performing a subarachnoid block for a Caesarean delivery. Patients can be placed in a left lateral tilt immediately after injection of local anaesthetic, without the fear of an inadequate block of the "non-dependent" parts. The Trendelenburg position can be used in case of hypotension without the risk of further cephalad spread of analgesia. Moreover, isobaric solutions seem to produce a consistent level of analgesia[12,13,17] and a more potent motor block[12,13,17,18] than hyperbaric solutions.

Glucose-free lidocaine, 2%, in doses of 3–4 ml has been used to produce satisfactory spinal anaesthesia in elderly patients for transuretheral surgery.[12–14] However, it has been suggested than the increased levels of progesterone in plasma and cerebrospinal fluid of parturients at term increase the central nervous system sensitivity to spinal anaesthesia. Moreover, the volume of the subarachnoid space in parturients is reduced due to venous engorgement in the epidural space and accounts for the decreased dose requirement in pregnancy. In this study we used 2, 2.5 and 3 ml of glucose and preservative-free lidocaine 2% for spinal anaesthesia for Caesarean section.

The onset of analgesia and motor block was fast and consistent. Differences in the cephalad spread were only present between the 2 ml and the 2.5 or 3 ml groups. The 2.5 and 3 ml groups were comparable in onset, duration of sensory and motor block, maximum cephalad spread and regression of the block. Maximum cephalad spread of analgesia was achieved in 10–15 min in all patients. The total range of maximum cephalad spread in 2 ml group was between T_4 and T_{10} with a mean of T_7 making it unsuitable for Caesarean section, as a T_4 level of sensory block is necessary for Caesarean section. The maximum cephalad spread of analgesia with 2.5 and 3 ml was more consistent, ranging from T_2 to T_6 and mean of $T_{4.1}$ in 2.5 ml group and range of T_1 to T_6 with a mean of $T_{3.6}$ in 3 ml group. There was a correlation between the cephalad spread of analgesia and the dose of lidocaine injected which is in accordance with previous studies on bupivacaine[19,20] and lidocaine.[12] The duration of motor block was also correlated with the dose of lidocaine injected, in agreement with the previous studies performed with isobaric lidocaine[12] and bupivacaine.[19–21]

Hypotension was noted in 10% of the patients and these were the patients with higher mean maximum spread of analgesia. Nausea and vomiting was also common in these patients. Post-dural puncture headache (PDPH) has increased incidence in parturients.[3] An incidence of 23% has been reported using a 25-gauge needle.[11] Turning the bevel of the spinal needle parallel to the longitudinal fibres of the dura reduces the incidence of PDPH.[22] By taking this precaution, the incidence of PDPH was reduced to 6% using a 23-guage needle.

All the neonates had Apgar scores greater than 7 at one minute and scores of 9 or 10 at five minutes.

In conclusion, 2.5 to 3 ml glucose-free lidocaine injected intrathecally to full term pregnant patients in the sitting position produced a rapid, reliable and clinically satisfactory spread of analgesia. Recovery of analgesia and motor block is expected within 2 to 2½ hr.

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