Regional Anesthesia and Pain

Selective spinal anesthesia for outpatient laparoscopy. I: Characteristics of three hypobaric solutions

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Purpose: To determine the characteristics and recovery profiles of three hypobaric spinal anesthetic solutions.

Methods: Thirty outpatients undergoing outpatient laparoscopy were randomly assigned to receive spinal anesthesia with one of three small-dose solutions. Group I - 20 mg lidocaine plus 25 μg fentanyl; Group II - 20 mg lidocaine plus 10 μg sufentanil; Group III - 10 mg lidocaine plus 10 μg sufentanil. Solutions were diluted to three ml with sterile water for injection. A 27-gauge Whitacre needle was inserted at L_{2-3} or L_{3-4} in the sitting position. Sensory and motor recovery were assessed with pinprick, proprioception, light touch and a modified Bromage scale.

Results: Operating conditions were good to excellent in all three groups. The incidence of shoulder tip discomfort, pruritus and nausea was not significantly different between groups. Light touch was present in all three groups and proprioception was present in most patients during and after surgery. Group III patients had a more rapid recovery of pinprick analgesia and Group II patients had the slowest recovery of pinprick analgesia. Motor block recovery was comparable in the three groups. Eighty percent of patients in Groups III and I were able to perform'deep knee bends' and 'straight leg raises' at the end of surgery.

Conclusion: For short duration laparoscopy, spinal 10 mg lidocaine with 10 μg sufentanil provided selective pin prick analgesia, with preserved touch, proprioception and limited motor block. Operating conditions were satisfactory and most patients were able to fulfill 'walk out' criteria at the end of surgery.

Objectif : Déterminer les caractéristiques de trois solutions anesthésiques rachidiennes hypobares et le type de récupération qu'elles entraînent.

Méthode : Trente patients ont été répartis de façon aléatoire et ont eu une rachianesthésie avec l'une des trois solutions à faible dose pour une laparoscopie ambulatoire. Dans le groupe I, il s'agit de 20 mg de lidocaïne plus 25 μg de fentanyl; dans le groupe II, de 20 mg de lidocaïne plus 10 μg de sufentanil et dans le groupe III, de 10 mg de lidocaïne plus 10 μg de sufentanil. Les solutions ont été complétées à 3 mL avec de l'eau stérile. Une aiguille Whitacre 27 a été insérée à L_{2-3} ou à L_{3-4} en position assise. La récupération sensitive et motrice a été évaluée par la réacion à la piqûre, la sensibilité proprioceptive, le toucher léger et une échelle de Bromage modifiée.

Résultats : Les conditions de l'intervention ont été de bonnes à excellentes dans les trois groupes. L'incidence d'un malaise à l'épaule, de prurit et de nausées n'a pas présenté de différence intergroupe significative. La sensibilité au toucher léger était présente chez les patients des trois groupes et la sensibilité proprioceptive chez la plupart des patients pendant et après l'opération. Les patients du groupe III ont connu la récupération la plus rapide au test de la piqûre et ceux du groupe II, la plus lente. La récupération motrice a été semblable dans les trois groupes. Des groupes III et I, 80 % des patients ont pu réaliser la flexion complète des jambes et la manoeuvre de Lasègue à la fin de l'intervention.

Conclusion : Dans le cas d'une laparoscopie de courte durée, l'administration rachidienne de 10 mg de lidocaïne avec 10 μg de sufentanil produit une analgésie sélective, conserve la sensation du toucher, la sensibilité proprioceptive et n'induit qu'un blocage moteur limité. Les patients, satisfaits des conditions générales, ont pu quitter à la fin de l'opération.

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PREVIOUS studies from our centre have demonstrated that small-dose hypobaric lidocaine-fentanyl spinal anesthetic technique provided effective anesthesia for short duration outpatient gynecological laparoscopy. It had a satisfactory rate of side effects and high patient acceptance. Advantages were demonstrated over conventional-dose hyperbaric lidocaine of no hypotension, minimal motor block, faster sensory recovery and, earlier discharge.[1,2] Subsequently, we demonstrated that at least 25 μg fentanyl needed to be added to 20 mg lidocaine to ensure reliable, durable spinal anesthesia, reduce shoulder tip pain, and minimize the need for intraoperative supplementation.[2] The purpose of the present study was to evaluate three small-dose hypobaric lidocaine based spinal solutions to determine their characteristics with particular respect to selective sensory and motor block, quality of surgical conditions and subsequent recovery.

Methods

After approval from the Clinical Screening Committee for Research and Other Studies of the University of British Columbia and informed consent, 30 ASA physical status I and II women scheduled for outpatient laparoscopy were enrolled in this randomized double blind study. Exclusions were neurological or neuromuscular diseases, infection at the intended site of spinal needle insertion, hypersensitivity to amide local anesthetic or fentanyl and sufentanil. Randomization was done with the help of a computer generated schedule followed by preparation of coded envelopes. Patients were randomly assigned to receive one of three hypobaric spinal anesthetic solutions:

Group I - 20 mg lidocaine 1% (2 ml, AstraZeneca, Mississauga, Ontario, Canada), mixed with 25 μg fentanyl (0.5 ml) and sterile water (0.5 ml). This mixture had a specific gravity of 1.005.(CSF specific gravity = 1.0069). Specific gravity was determined with a refractometer (American Optical Company, Chicago, USA).

Group II - 20 mg lidocaine 1 % (2 ml), mixed with 10 μg sufentanil (0.2 ml) and sterile water (0.8 ml). This mixture had a specific gravity of 1.0045.

Group III - 10 mg lidocaine 1 % (1 ml), mixed with 10 μg sufentanil (0.2 ml) and sterile water (1.8 ml). This mixture had a specific gravity of 1.002.

All spinal solutions were prepared aseptically by one of the investigators after following instructions in sealed randomization envelopes. All patients had an intravenous cannula inserted in the preoperative lounge and 1 L normal saline was infused, although no specific pre-load was given. All patients walked into the operating room unassisted, as is the practice in our day care unit. Upon arrival in the operating room, routine monitors were applied (ECG, automatic blood pressure and pulse oximeter). The spinal anesthetic was administered by a standardized technique. With the patient in sitting position, a midline approach at L_{2-3} or L_{3-4} was used after subcutaneous local anesthetic infiltration with lidocaine 1%. A 27-gauge Whitacre point spinal needle was inserted with the orifice pointing cephalad and without the aid of an introducer. The spinal solution was injected rapidly ($0.5\ ml{\cdot}sec^{-1}$).[3] After one minute, patients were placed in reverse Trendelenburg position (15-20) until the level of sensory anesthesia (tested to pinprick) reached T_6. During this time interval the patient's legs were placed in lithotomy stirrups and the perineum and abdomen were surgically prepared.

A standardized surgical technique was used for laparoscopy. Before insufflation of the abdomen with CO_2, the OR table was returned to horizontal position to minimize the amount of CO_2 collecting under the patient's diaphragm. Three to four litres of CO_2 were insufflated followed by insertion of infra-umbilical and suprapubic trocars and ports. Shoulder tip pain (referred from the effects of CO_2 on the peritoneal surface of the diaphragm) was treated with 250-500 μg alfentanil increments *iv*. Midazolam, 1-2 mg *iv*, was administered for sedation if necessary. After insertion of the laparoscope, Trendelenburg position (15-20) was allowed as required.

Sensory block was determined by pinprick with an 18-gauge needle and light touch was assessed with cotton wool along the mid-axillary line, outer aspects of the thigh, leg and foot. Proprioception was tested at the big toe by asking the patient to identify movements of the toe without looking. Motor block was assessed with a modified Bromage scale[1–2] :

1=complete motor block;
2= able to move feet only;
3=able to move feet and knees;
4=able to perform a straight leg raise;
5=able to perform a 'deep knee bend'.

Observations were made at 3,5,30,45,60,75 and 90 min after spinal injection. Deep knee bends could not be assessed at three and five minutes because the patient was being prepared for surgery. Surgical conditions were rated blindly by the surgeon on an ordinal scale (poor, good or excellent). Side effects such as shoulder tip pain, nausea and pruritus (defined as itching over the area of spinal block) were also documented. Ability to achieve 'walk-out' criteria was tested at the end of surgery while the patients were in the OR by asking them to perform a 'straight leg raise' and a 'deep knee bend'- further assessments were per-

formed in the PACU on arrival and at 30,45,60,75 and 90 min. Full sensory assessment was also performed in all patients on arrival in the PACU and at 15 min intervals thereafter.

Observations in the OR were made by a blinded investigator and in the PACU by recovery nurses who were also blinded. Patients were discharged from the PACU after meeting the following standard criteria for our unit:

1) oriented;
2) stable vital signs;
3) no surgical complications;
4) absence of side effects;
5) adequate pain control; and
6) resolution of motor block and sensory block at or below S_3.

Power analysis was performed while designing the study. Allowing an of 0.05 and a ß of 0.2 it was estimated that a minimum of nine patients per group would be required to show a 50% difference in resolution of motor block assuming that the control group would be 30 ± 10 min. It is important to note that smaller differences may not be detected with such a sample size. However, it was felt that differences smaller than these were not of clinical interest to us.

Statistical analysis was performed using the Number Cruncher Statistical System (version 7.0). All data that were continuous and numerical were tested for normality using the Martinez-Iglewicz, the Kolmorgorov-Smirnov and the D'Agostino-Pearson Omnibus K^2 tests. Skewed data were summarized as median(range) and analyzed for between group differences using Kruskal-Wallis tests. Categorical data were analysed by Chi-square or Fisher exact test as appropriate. Bonferroni's correction was applied for multiple corrections. A value of $P < 0.05$ was considered significant.

Results

There were 30 ASA I-II patients in the study and all three groups were comparable with respect to demographics (Table I). Intraoperative outcomes are shown in Table II. All patients were successfully operated upon and conditions were good to excellent. None of the patients complained of abdominal discomfort. Two patients in Group III presented for diagnostic laparoscopy as part of a work up for infertility. During insufflation of intraperitoneal CO_2, the surgeon noted that the rectus abdomini muscles became tense and this was relieved by 1-2 mg midazolam *iv*. The incidence of shoulder tip pain, pruritus and nausea was not different among the three groups. Supplemental use of alfentanil for shoulder tip discomfort was also comparable among groups. Patients in Group III required more sedation than those in Group II. Postoperative outcomes are shown in Table III. Only one patient in Groups I and II received analgesia in the PACU. None of the patients in Group III required analgesia in the PACU. Group I and II patients

TABLE I Demographic data

	Group I	*Group II*	*Group III*
n	10	10	10
Age (yr)	32 (24-47)	34 (21-40)	35 (23-41)
Weight (kg)	58 (47-80)	56 (49-105)	62 (52-87)
Surgery			
Tubal sterilization	5	7	7
Dye pertubation	2		1
Diagnostic	2	2	
Other	1	1	2
# of Spinal attempts (1/2/3)	10/0/0	10/0/0	8/1/1
Duration of surgery(min)	11 (10-57)	13 (10-32)	17 (10-87)

Values are counts or median (range).

TABLE II Intraoperative outcomes.

	Group I	*Group II*	*Group III*
n	10	10	10
Surgical conditions			
Excellent/Good	9/1	9/1	8/2
Shoulder tip pain %	100	70	60
Nausea %	10	10	20
Pruritus %	50	50	80
Supplementation			
Alfentanil (µg)	250 (0-1000)	125 (0-500)	375 (0-1000)
Midazolam (mg)	0 (0-2)	0	0.5 (0-2)*
During surgery:			
Light touch present %	100	100	100
Proprioception present %	100	90	100

Values are counts, percentages or median (range).
* $P < 0.05$ *vs* Group II.

TABLE III Postoperative outcomes.

	Group I	*Group II*	*Group III*
Recovery (min):			
Sensory block $\leq S_3$	105 (75-120)	135 (90-150)	90 (75-105)*
Motor block ≥5	18 (16-63)	34 (17-83)	26 (18-39)
Analgesics in PACU:			
Acetaminophen %	10	0	0
Aspirin %	0	10	0
On arrival in PACU:			
Light touch present %	100	100	100
Proprioception present %	100	100	100
Able to do deep knee bends and straight leg raises %	80	50	80

Values are percent, count or median (range).
* $P < 0.001$ *vs* Groups I and II.

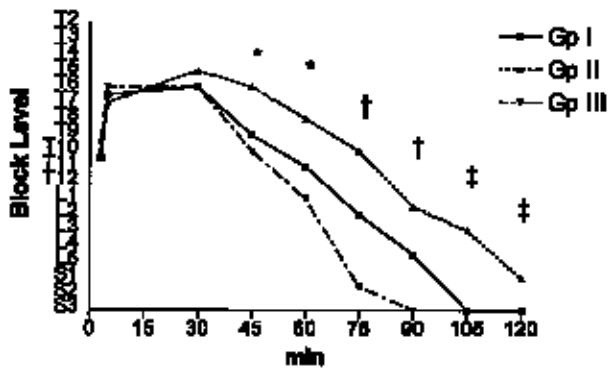

FIGURE 1 Change in sensory block level (median) over time. * $P < 0.05$ for Gp III *vs* Gp II; † $P < 0.05$ for Gp III *vs* Gp I and II; ‡ $P < 0.05$ for Gp II *vs* Gp I and III. Spinal anesthesia was administered at time=0.

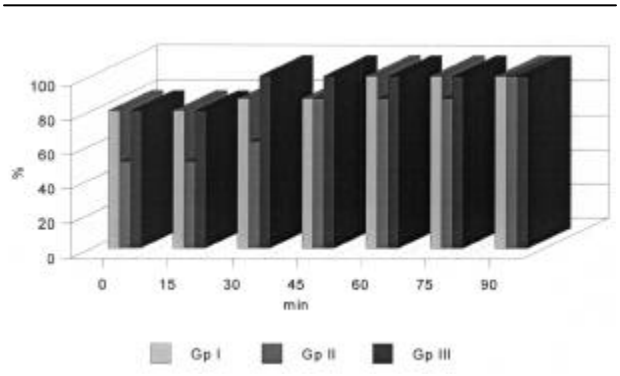

FIGURE 2 Percent of patients able to perform a deep knee bend over time in PACU. (0=arrival in PACU).

required either acetaminophen or aspirin in the PACU. Regression of pin prick analgesia (Figure 1) was faster in Group III although all three groups were comparable with respect to recovery of motor block in PACU (Figure 2). Proprioception and light touch were preserved in all patients in all three groups during surgery and in the PACU. No patients fell during the study when ability to achieve 'walk out' criteria was tested at the end of surgery.

Discussion

This study has shown that small-dose selective spinal anesthesia can be achieved with 10-20 mg hypobaric lidocaine when mixed with either 25 µg fentanyl or 10 µg sufentanil. Operating conditions were judged good-excellent and most patients had minimal motor block, preserved light touch and proprioception. However, 10 mg lidocaine mixed with 10 µg sufentanil was associated with faster recovery of pinprick analgesia and 80 % of patients were able to achieve 'walk out' criteria on arrival in the PACU.

Selective spinal anesthesia(SSA) has been defined [4] as "the practice of employing minimal doses of intrathecal agents so that only the nerve roots supplying a specific area and only the modalities that require to be anesthetized are affected." This study has confirmed that patients tolerate surgery with SSA. It is important to emphasize that since light touch and proprioception are preserved, patients are aware of stimuli such as preparation of the skin and perineum, insertion of instruments into the vagina and pulling on the abdominal wall during insertion of surgical trocars. However, they do not feel any pain with any surgical stimulus and need to be reassured. Occasionally, a nervous patient may require sedation with 1-2 mg midazolam *iv*. Distension of the abdomen with intraperitoneal CO_2 is typically described by patients as a heavy weight on the abdomen. During surgery, the Trendelenburg position is well tolerated with minimal effect on respiration.[1–2] Although differential nerve block has been described with spinal and epidural anesthesia,[5–6] there are no reports of such a concept being explored for outpatient use to facilitate rapid recovery. Our study demonstrated the advantages of utilizing differential neuraxial block to facilitate rapid recovery. However, before such patients can be allowed to bypass the PACU, it will be necessary to perform a detailed study of spinal cord function with SSA- this has been reported by us in a companion study.[7]

The extent of surgical procedures, duration of surgery and the weight of patients in Group III is summarized in Table I. Patients weighing up to 87 kg were able to tolerate laparoscopy with this technique. In some patients the procedures took up to 87 min and was tolerated without problems. No conversions to general anesthesia were required. Our study results suggest that replacement of intrathecal fentanyl with sufentanil allows further reductions in spinal lidocaine dose to be achieved with minor compromise of surgical conditions. However, the administration of small doses of midazolam was therapeutic and allowed surgery to be completed without conversion to general anesthesia. In addition, there was an added benefit of faster recovery of pin prick analgesia.

The incidence of shoulder tip pain was comparable to that reported in our earlier studies.[1–2]However, the incidence of nausea was less (10-20%) compared with the 24-29% reported previously and the incidence of pruritus was comparable to our previous studies.[1–2]

Extent of motor block of the lower limbs during and after surgery was not different between groups. Most patients had minimal motor block of the lower limbs during surgery (Figure 2). This may be disconcerting to the inexperienced surgeon and anesthesiologist. However, it seems that adequate surgical relaxation of the abdominal wall is achieved with all three spinal solutions. Since we were using such a low dose of local anesthetic in Group III, it may be tempting to speculate whether laparoscopy could be performed without any spinal local anesthetic. The ability to perform laparoscopy without local anesthetic, using sufentanil alone has been studied and reported by us in an accompanying paper.[8] We observed that patients whose abdominal wall has not been stretched by a previous pregnancy may develop a tense rectus abdominus muscle during intraperitoneal CO_2 insufflation. Such a problem occurred in two patients in Group III but was easily managed by administration of intravenous midazolam 1-2 mg. Thus, in the nulliparous female presenting for diagnostic laparosopy, it may be easier to consider using lidocaine 20 mg as per Groups I and II until the surgeon and anesthesiologist become comfortable with this technique. Complete recovery of motor block (score=5) was not different among groups and occurred 18-34 min after injection of spinal anesthetic (Table III).

In conclusion, this study found that outpatient laparoscopy is possible with small-dose selective spinal anesthesia and, a majority of patients have preserved light touch and proprioception during and after surgery. In addition, most patients were able to achieve 'walk out' criteria at the conclusion of surgery. However, 10 mg lidocaine with 10 μg sufentanil was associated with faster recovery of pin prick analgesia.

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