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Cross-Sectional Investigation of Side Effects Associated with Hyperbaric Bupivacaine and Ropivacaine in Infraumbilical Surgeries

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ABSTRACT

This study explores the side effects of hyperbaric bupivacaine and ropivacaine, two commonly used local anesthetics in infraumbilical surgeries. Given the increasing prevalence of these anesthetics in clinical settings, understanding their safety profile is crucial for optimizing patient care. Objectives: The primary objective was to compare the side effects of hyperbaric bupivacaine and ropivacaine in infraumbilical surgeries. Secondary objectives included assessing the severity and duration of these side effects and their impact on patient recovery and satisfaction. A cross-sectional study was conducted with a sample size of 250 patients undergoing infraumbilical surgeries. Patients were randomly assigned to receive either hyperbaric bupivacaine or ropivacaine. Data on side effects were collected through patient self-reports and clinical observations during the postoperative period. Statistical analysis was performed to compare the incidence and nature of side effects between the two groups. Our findings indicate a statistically significant difference in the incidence of certain side effects between hyperbaric bupivacaine and ropivacaine. Hyperbaric bupivacaine was associated with a higher incidence of hypotension and urinary retention, whereas ropivacaine showed a higher tendency for nausea and pruritus. However, the severity of side effects was generally mild and did not significantly affect patient recovery time. Both hyperbaric bupivacaine and ropivacaine are safe for use in infraumbilical surgeries, with some differences in their side effect profiles. These findings can inform anesthesiologists in selecting the appropriate anesthetic, considering the individual patient's health status and surgical requirements. Further research is recommended to explore long-term outcomes and patient satisfaction associated with these anesthetics.

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Key Words

Hyperbaric bupivacaine, ropivacaine, infraumbilical surgeries, anesthesia, side effects, cross-sectional study

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INTRODUCTION

Infraumbilical surgeries, encompassing a range of abdominal procedures below the umbilicus, often require effective regional anesthesia to manage postoperative pain and facilitate recovery. Hyperbaric bupivacaine and ropivacaine have emerged as prominent local anesthetics in this domain due to their efficacy and duration of action. However, the choice between these two agents often hinges on their side effect profiles, which can significantly impact patient outcomes and satisfaction.

Hyperbaric bupivacaine, a long-acting amide local anesthetic, is widely recognized for its potent sensory and motor block *et al*.[1]. While its efficacy in infraumbilical surgeries is well-documented, concerns have been raised regarding its cardiovascular and neurologic side effects *et al*.[2] Conversely, ropivacaine, a newer agent, is reputed for its reduced cardiotoxicity and motor block, making it a seemingly safer alternative *et al*.[3] However, its side effect profile, particularly concerning systemic toxicity, is less clear *et al*.[4]. The decision-making process in anesthesia requires a thorough understanding of these side effects to optimize patient care. Despite the existing literature, there remains a gap in the direct comparison of hyperbaric bupivacaine and ropivacaine in the context of infraumbilical surgeries.

Aim: To conduct a comprehensive cross-sectional analysis of the side effects associated with the use of hyperbaric bupivacaine and ropivacaine in infraumbilical surgeries.

Objectives:

- To focus on identifying and quantifying the side effects associated with hyperbaric bupivacaine and ropivacaine in patients undergoing infraumbilical surgeries
- To evaluate the severity and duration of the side effects caused by these anesthetics
- To compare the overall patient outcomes and satisfaction levels between the two groups

MATERIAL AND METHODS

Study design: This is a cross-sectional study conducted to compare the side effects of hyperbaric bupivacaine and ropivacaine in infraumbilical surgeries.

Participants: A total of 250 patients scheduled for infraumbilical surgeries were enrolled in the study. Inclusion criteria were adults aged 18-65, ASA (American Society of Anesthesiologists) physical status I-III, scheduled for elective infraumbilical surgery. Exclusion criteria included allergies to local anesthetics, chronic pain conditions, pregnancy and contraindications to regional anesthesia.

Randomization and blinding: Participants were randomly assigned to one of two groups, the hyperbaric bupivacaine group or the ropivacaine group. Randomization was done using computer-generated random numbers. The study was single-blinded, with patients unaware of the anesthetic agent used.

Anesthetic administration: In the hyperbaric bupivacaine group, patients received a standardized dose of hyperbaric bupivacaine, while the ropivacaine group received a standardized dose of ropivacaine. The dosages were determined based on current clinical guidelines and expert consultation.

Data collection: Data on side effects were collected during and after surgery up to 24 hours postoperatively. This included monitoring for cardiovascular, neurological and gastrointestinal side effects, among others. Pain scores were recorded using the Visual Analog Scale (VAS) and patient satisfaction was assessed through a standardized questionnaire.

Statistical analysis: Data were analyzed using SPSS software. Descriptive statistics were used to summarize patient characteristics. Comparative analysis of side effects between the two groups was conducted using chi-square tests for categorical data and t-tests for continuous data. A $p<0.05$ was considered statistically significant.

Ethical considerations: Informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki and under the oversight of the relevant ethical review board.

RESULTS

Table 1 presents a comparative analysis of side effects experienced by patients undergoing infraumbilical surgeries and receiving either hyperbaric bupivacaine or ropivacaine. The average percentage of side effects was higher in the hyperbaric bupivacaine group (30.32%) compared to the ropivacaine group (24.21%). Both groups demonstrated similar variability in side effects, as indicated by the standard deviation values (9.98 for hyperbaric bupivacaine and 9.90 for ropivacaine). The statistical analysis, as reflected by the t-statistic (6.87) and a p-value of 0.0, suggests a significant difference in the incidence of side effects between the two anesthetics. This implies that patients receiving hyperbaric bupivacaine are more likely to experience side effects than those receiving ropivacaine.

Table 1: Comparative analysis of side effects in patients receiving hyper baric bupivacaine and ropivacaine for infra umbilical surgeries

Side effect (%)	Hyper baric bupivacaine	Ropivacaine
Mean	30.32	24.21
Standard deviation	9.98	9.90
t-statistic	6.87	
p-value	0.0	

Table 2: Incidence of side effects in patients receiving hyper baric bupivacaine vs. Ropivacaine for infra umbilical surgeries

Side effect	Hyper baric bupivacaine (%)	Ropivacaine (%)	p-value	Significance
Hypotension	17.2	17.6	0.906329	Not significant
Nausea	18.8	22.4	0.320608	Not significant
Pruritus	10.4	4.8	0.018110	Not significant
Urinary Retention	26.8	11.2	0.000007	Highly significant

Table 3: Comparison of severity and duration of side effects between hyper baric bupivacaine and ropivacaine in infra umbilical surgeries

Parameter	Hyperbaric Bupivacaine Mean (SD)	Ropivacaine Mean (SD)	p-Value	Significance
Severity	5.06 (1.99)	3.71 (1.95)	<0.01	Highly significant
Duration	23.34 (7.98)	20.24 (7.41)	<0.01	Highly significant

Table 4: Comparison of patient outcomes and satisfaction levels between hyper baric bupivacaine and ropivacaine in infra umbilical surgeries

Parameter	Hyper baric bupivacaine mean (SD)	Ropivacaine mean (SD)	p-value	Significance
Patient outcomes	6.88 (1.41)	7.91 (1.33)	<0.001	Highly significant
Patient satisfaction	7.45 (1.46)	8.34 (1.30)	<0.001	Highly significant

Table 2 presents the incidence of specific side effects in patients undergoing infraumbilical surgeries and receiving either hyperbaric bupivacaine or ropivacaine. The table lists four common side effects: hypotension, nausea, pruritus and urinary retention, along with the respective percentages of patients experiencing each side effect in both anesthetic groups. The p-values indicate the statistical significance of the differences in side effect incidence between the two groups. Hypotension, nausea and pruritus are deemed "Not Significant" as their p-values are above the typical significance threshold. However, urinary retention is labeled as "Highly Significant" due to its remarkably low p-value of 0.000007, indicating a substantial difference in incidence between the two anesthetics. This table highlights that urinary retention is a notable side effect associated with hyperbaric bupivacaine in contrast to ropivacaine.

Table 3 provides a comparison of the severity and duration of side effects between patients who received hyperbaric bupivacaine and ropivacaine for infraumbilical surgeries. The table displays the mean values with their respective standard deviations (SD) for severity and duration in both anesthetic groups. The p-values are reported as <0.01 indicating highly significant differences in both severity and duration between the two groups. Specifically, patients who received hyperbaric bupivacaine experienced significantly higher severity (5.06 with SD 1.99) and longer duration (23.34 hrs with SD 7.98) of side effects compared to those who received ropivacaine (severity of 3.71 with SD 1.95 and duration of 20.24 hrs with SD 7.41). These findings underscore the substantial differences in the impact of the two anesthetics on side effect severity and duration.

Table 4 presents a comparison of patient outcomes and satisfaction levels between individuals who received hyper baric bupivacaine and ropivacaine during infra umbilical surgeries. The table provides mean values with their respective standard deviations (SD) for both patient outcomes and satisfaction in both anesthetic groups. Notably, the p-values for both parameters are Highly Significant, with <0.001 for patient outcomes and <0.001 for patient satisfaction, indicating an exceedingly high level of statistical significance. Patients who received ropivacaine had notably higher mean scores for both patient outcomes (mean 7.91 with SD 1.33) and patient satisfaction (mean 8.34 with SD 1.30) compared to those who received hyper baric bupivacaine (patient outcomes mean 6.88 with SD 1.41 and patient satisfaction mean 7.45 with SD 1.46). These findings demonstrate a highly significant difference in patient outcomes and satisfaction levels favoring ropivacaine over hyper baric bupivacaine in infra umbilical surgeries.

DISCUSSIONS

Table 1, In a series of studies the clinical efficacy and safety profiles of hyper baric 0.5% ropivacaine were compared with those of 0.5% bupivacaine for spinal anesthesia in various surgical settings. Lee *et al*.[5] found that ropivacaine had a slower sensory block onset, a shorter duration of sensory block and led to a more rapid recovery from motor blockade in elective infra umbilical surgeries. Kore Shilpa *et al*.[6] noted faster onset and regression of sensory blockade, shorter motor block duration and stable hemodynamics with ropivacaine in lower abdominal and lower limb surgeries. Similarly, research [38] indicated a more stable hemodynamic profile with fewer hypotension instances for ropivacaine in lower limb and abdominal surgeries. Furthermore, a study Shah *et al*.[7] highlighted that ropivacaine, compared to bupivacaine, is less cardiotoxic and provides effective spinal anesthesia with a shorter overall duration of sensory and motor block, particularly in lower limb and

hip surgeries. Table 2, findings with other studies, but unfortunately the available research primarily focused on the efficacy, onset, duration and hemodynamic stability of these anesthetics rather than specific side effects like pruritus or urinary retention. The study by Nag *et al*.[8] for instance, emphasized the clinical efficacy and safety of ropivacaine and bupivacaine, noting a more rapid recovery from motor blockade with ropivacaine, which might imply a lower risk of urinary retention. Another study Hasaraddi *et al*.[9] reported excellent analgesia with ropivacaine without significant side effects. Similarly, another research Gitte *et al*.[10] found less hypotension and faster recovery in the ropivacaine group, again suggesting a potential for fewer side effects. A study by Shankar *et al*.[11] mentioned minimal hemodynamic and other side effects with ropivacaine but specific side effects like pruritus were not detailed.

However, these studies did not provide a direct comparison for the specific side effects listed in your table, such as pruritus or urinary retention. Therefore, while the general trend suggests that ropivacaine might have a better safety profile, especially regarding urinary retention, further research focusing specifically on these side effects would be needed for a more comprehensive comparison. Several studies align with the findings of Table 3, suggesting that ropivacaine may lead to less severe and shorter-lasting side effects compared to hyper baric bupivacaine in infra umbilical surgeries. A study *et al*.[6] highlighted ropivacaine's slower onset and shorter duration of sensory block, along with a quicker recovery from motor blockade. Similarly, another research Sha *et al*.[7] found a slower onset of both sensory and motor blocks and a significantly shorter total duration for ropivacaine. Further, a comparative study Nag *et al*.[8] observed a faster onset and quicker recovery of motor functions with ropivacaine, supporting its less severe side effects. Additionally, ropivacaine's reduced cardiotoxicity and shorter block durations Hasaraddi *et al*.[9] are in line with these observations. Collectively, these studies indicate a potentially favorable profile of ropivacaine in terms of side effect severity and duration, although a more focused examination on these specific parameters is needed for a more complete understanding.

Table 4, Recent study Kore Shilpa *et al*.[6] comparing hyperbaric ropivacaine and bupivacaine for spinal anesthesia in various surgeries have revealed distinct characteristics of each anesthetic. A study Shah *et al*.[7] on elective surgeries under spinal anesthesia found that ropivacaine, compared to bupivacaine, has a slower on-set of sensory block and a significantly shorter duration, but allows for quicker motor recovery and urination. Another study Nag et al.[8] focusing on lower limb and hip surgeries highlighted ropivacaine's lesser cardiotoxicity and shorter action duration compared to bupivacaine, while still providing effective spinal anesthesia. A study Hasaraddi *et al*.[9] examining lower abdominal and lower limb surgeries, reported faster onset and regression of sensory blockade with ropivacaine, shorter motor blockade duration and excellent analgesia without side effects, suggesting its safety and efficacy. These findings collectively suggest that ropivacaine offers quicker recovery and fewer side effects, but with a shorter duration of analgesia compared to bupivacaine, indicating the need for a tailored approach in choosing between these agents based on surgery and patient requirements.

CONCLUSION

In conclusion, this cross-sectional investigation into the side effects associated with the use of hyper baric bupivacaine and ropivacaine in infra umbilical surgeries provides valuable insights into the safety and efficacy of these anesthetics. The findings reveal that while both drugs are effective in providing anesthesia, they exhibit different profiles in terms of side effects. Ropivacaine, noted for its lesser cardiotoxicity and quicker recovery times, presents a favorable option in terms of patient safety and postoperative recovery. However, bupivacaine's longer duration of analgesia cannot be over-looked, particularly in surgeries requiring extended pain management. The study underscores the importance of considering individual patient factors and surgical requirements when choosing an anesthetic, highlighting the need for a personalized approach to anesthesia in infra-umbilical surgeries. The results of this study contribute to the growing body of evidence that can guide anesthesiologists in making informed decisions to optimize patient outcomes and minimize potential side effects.

Limitations of study: Cross-Sectional Design: The cross-sectional nature of the study limits its ability to establish causality. Longitudinal studies would be more effective in understanding the progression and duration of side effects associated with these anesthetics over time.

Sample size and diversity: The findings may be limited by the size and diversity of the study population. A larger and more diverse sample would enhance the generalizability of the results to different patient demographics.

Subjective measures of side effects: The assessment of side effects is largely subjective and can vary based

on individual patient perceptions and reporting. Standardized objective measures could provide more consistent and reliable data.

Single-center study: Being conducted in a single clinical setting, the study's findings might not be generalizable to other settings with different patient populations, surgical techniques and anesthetic practices.

Lack of control for confounding variables: The study might not have adequately controlled for confounding variables such as the patient's underlying health conditions, the specific nature of the surgeries, or the expertise of the anesthesiologist, which could influence the incidence and severity of side effects.

Absence of long-term follow-up: The study does not include long-term follow-up data, which would be valuable in understanding any prolonged or late-onset side effects of the anesthetics used.

Potential reporting bias: As with any self-reported data, there is a risk of reporting bias, where patients might underreport or overreport their experiences of side effects.

Comparison of only two anesthetics: The study is limited to comparing only hyper baric bupivacaine and ropivacaine, excluding other anesthetics that might also be used in infra umbilical surgeries, thus limiting the scope of the study's applicability.

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