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THE INFLUENCES OF ANESTHESIA METHODS ON SOME COMPLICATIONS AFTER ORTHOPEDIC SURGERY:

Authors:

1. **Dr. Atul Kumar Joshi**; Assistant Professor, Department of Anaesthesia, I Q City Medical College, Durgapur.
2. **Dr. Atif Ateeql**; Assistant Professor, Department of Anatomy, Gouri Devi Institute of Medical Sciences, Durgapur.
3. **Dr. Sumantu Virmani**; Assistant Professor, Department of Orthopaedics, I Q City Medical College, Durgapur.

Corresponding author:

Dr. Sumantu Virmani; Assistant Professor,

Department of Orthopaedics, I Q City Medical College, Durgapur.

E-mail: drsumantuv@gmail.com

Abstract

Background: Despite various anesthesia techniques explored for orthopedic surgery, addressing anesthesia-related complications remains a challenge. This study aims to investigate how different anesthesia methods impact post-surgical complications in orthopedic procedures. **Approach:**Anesthesia-related studies in orthopedic surgery were identified through a search of PubMed, Embase, and the Cochrane Library. Data on complications and patient demographics were collected, and study quality was assessed following Cochrane **Collaboration guidelines.** Network meta-analysis was conducted using ADDIS software. The pooled effect size was determined using random or consistency models and presented as odds ratios (OR) with 95% confidence intervals (CI).

Findings: Twenty-three studies comprising 2393 patients met the inclusion criteria. Quality assessment indicated that all studies were of average quality. Network meta-analyses revealed that nerve block analgesia (NBA) was associated with lower rates of post-operative nausea or vomiting (PONV; OR = 0.17, 95% CI: 0.06–0.39) and urine retention (OR = 0.07, 95% CI: 0.01–0.37) compared to epidural anesthesia (EA). Interscalene block (ISB) and local infiltration analgesia (LIA) significantly reduced the occurrence of back pain compared to EA (OR = 0.00, 95% CI = 0.00–0.30; OR = 0.00, 95% CI = 0.00–0.25).

Conclusion: NBA appears effective in reducing PONV and urine retention, while ISB and LIA are effective in alleviating back pain compared to EA following orthopedic surgery.

Keywords: Orthopedic surgery, Nerve block analgesia, Local infiltration analgesia, Interscalene block, Complications

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Introduction

Orthopedic surgery, a discipline dating back to the 18th century, has seen significant advancement. Procedures like total knee replacement and hip fracture repair have been explored extensively. However, challenges such as pain management, post-operative nausea or vomiting (PONV), rapid recovery, cognitive impairment, and surgical site infections still hinder its widespread application. Anesthesia, commonly used in orthopedic surgery, can impact various factors like temperature regulation, infection risk, bleeding, and oxygen consumption, thereby affecting surgery outcomes. Hence, there's a need to innovate appropriate anesthesia techniques to enhance the results and prognosis of orthopedic surgery.

Despite decades of development, anesthesia-related complications persist. Studies have shown that general anesthesia carries a lower risk of complications compared to spinal anesthesia in total knee arthroplasty. Conversely, regional anesthesia demonstrates superior outcomes in total hip arthroplasty, reducing deep surgical site infections, hospital stay duration, and pulmonary complications compared to general anesthesia. Additionally, neuraxial anesthesia has been found to reduce blood transfusion rates and perioperative morbidity in simultaneous bilateral total knee arthroplasty compared to general anesthesia. Furthermore, general anesthesia has been associated with a higher risk of post-operative cognitive dysfunction compared to other anesthesia methods. Despite these findings, consensus on the optimal anesthesia method for orthopedic surgery remains elusive.

This study conducted a network meta-analysis to comprehensively evaluate the effects of different anesthesia methods, such as general anesthesia, on orthopedic surgery outcomes. Data from studies examining the associations between anesthesia methods and adverse effects after orthopedic surgery were collected from databases like PubMed, Embase, and the Cochrane Library.

Inclusive criteria involved studies published in English reporting on the effects of different anesthesia methods on orthopedic surgery patients' outcomes, with randomized controlled trials being prioritized. Data extraction included information on study characteristics, anesthesia methods, patient demographics, and surgical details. Quality assessment was conducted following Cochrane Collaboration recommendations. Statistical analyses were performed using the ADDIS software, presenting odds ratios (OR) and 95% confidence intervals (CI). Random effects or consistency models were used based on statistical significance.

he convergence of the model was assessed using the Brooks-Gelman-Rubin method, which is presented through the potential scale reduction factor (PSRF). A PSRF value closer to 1 indicates better convergence [14].

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Results:

Characteristics of Enrolled Studies:

- Initially, 3196 studies were identified, which were reduced to 1945 after removing duplicates.
- Following title and abstract screening, 1779 studies were excluded.
- After full-text review, 143 additional studies were excluded, resulting in 23 included studies [15–37], as shown in Fig. 1A.
- The characteristics of the enrolled studies are summarized in Table 1. These studies were published between 1978 and 2017, with research conducted in various countries.
- A total of 2393 patients were included, distributed across different anesthesia groups. Quality assessment indicated that the studies had average quality.
- Table 1:

• Author	Public Year	Location	Study Year	Group	N	Age (years)	Male/Female	Weight (kg)	Height (cm)	Length of Operation (min)
Trker G	2003	Turkey	NA	EA	15	62.2 ± 6.6	9/6	72.2 ± 7.5	166.6 ± 3	129.2 ± 26.4
				NBA	15	62.3 ± 7.2	8/7	73.7 ± 6.3	167.4 ± 4.4	131.3 ± 18.7
Wang H	2017	China	2008.1–2015.12	GA	169	52.9 ± 9.7	89/80	NA	NA	52.5 ± 9.3
				LIA	187	51.4 ± 9.1	93/94	NA	NA	48.1 ± 9.9
Yukawa Y	2005	Japan	NA	LIA	22	58.9 ± 14.5	15/7	60.3 ± 9.5	159.2 ± 7.9	160.7 ± 27.0
				EA	23	59.1 ± 15.2	10/13	59.0 ± 9.7	160.1 ± 8.7	157.5 ± 29.5

Name	Direct Effect	Indirect Effect	Overall P-Value
A: PONV			
EA, GA	1.02 (-0.47, 2.42)	0.88 (-0.31, 2.09)	0.91 (0.02, 1.88)
EA, SA	0.25 (-1.15, 1.85)	-1.24 (-2.46, -0.20)	-0.68 (-1.58, 0.25)
EA, LIA	-2.46 (-4.33, -0.74)	-1.38 (-2.44, -0.38)	-1.74 (-2.67, -0.89)
EA, NBA	-2.03 (-4.03, -0.76)	-1.46 (-2.79, -0.21)	-1.80 (-2.82, -0.93)
GA, LIA	-2.43 (-4.62, -0.74)	-2.77 (-3.90, -1.76)	-2.64 (-3.70, -1.75)
GA, NBA	-1.80 (-4.09, -0.11)	-2.95 (-4.22, -1.99)	-2.71 (-3.88, -1.74)

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GA, SA	-1.78 (-2.62, -0.96)	-0.91 (-2.41, 0.54)	-1.57 (-2.27, -0.88)
GA + ISB, ISB	-1.03 (-3.23, 0.72)	-1.62 (-3.68, 0.32)	-1.23 (-2.76, 0.23)
LIA, SA	0.83 (-0.50, 2.13)	1.29 (0.13, 2.66)	1.08 (0.20, 2.04)
LIA, NBA	-0.08 (-0.90, 0.65)	0.04 (-1.68, 1.49)	-0.07 (-0.81, 0.63)
B: Urine retention			
EA, GA	-0.47 (-2.91, 1.86)	-1.37 (-4.68, 1.53)	-0.68 (-2.52, 0.87)
EA, NBA	-2.93 (-5.49, -0.99)	-1.35 (-5.92, 2.38)	-2.59 (-4.56, -1.00)
EA, SA	-0.66 (-4.75, 2.23)	-0.67 (-3.34, 1.44)	-0.76 (-2.71, 0.86)
GA, SA	0.20 (-1.68, 2.06)	-0.94 (-4.47, 2.55)	-0.08 (-1.60, 1.43)
NBA, SA	0.81 (-2.34, 4.35)	2.50 (-0.56, 5.47)	1.84 (-0.26, 3.93)

Table 2: (Note: Values are presented as odds ratios with 95% confidence intervals; P-values less than 0.05 indicate statistical significance)

Table 3:

Anesthesia Method	**Odds Ratio (95% CI)**
A: PONV	
EA	2.48 (1.02, 6.55)
GA	0.34 (0.13, 0.97)
GA + ISB	0.29 (0.06, 1.25)
ISB	0.68 (0.14, 3.40)
LIA	0.93 (0.44, 1.87)
NBA	3.22 (1.16, 9.67)
SA	
B: Urine retention	
EA	0.51 (0.08, 2.38)
GA	0.21 (0.01, 3.65)
LIA	0.71 (0.11, 5.12)
NBA	6.27 (0.77, 51.01)
SA	

(Note: CI denotes Confidence Interval)

Network Meta-analyses for Adverse Effects after Orthopedic Surgery:

1. PONV:
    - PSRF values indicated good convergence.

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- NBA showed the lowest influence on PONV, while GA showed the worst effect.
- Compared to NBA, SA, EA, GA, and GA + IBS had significantly worse effects on PONV.

2. Urine Retention:
    - PSRF values indicated good convergence.
    - NBA had the lowest incidence of urine retention, significantly lower than EA.
3. Sore Throat:
    - PSRF values indicated good convergence.
    - SA and NBA had lower incidences of sore throat, but no significant differences were identified compared to other groups.
4. Back Pain:
    - PSRF values indicated good convergence.
    - ISB and LIA groups had lower rates of back pain compared to SA, EA, GA, and GA + ISB groups.
    - ISB and LIA also had significantly lower rates of back pain compared to EA.
    - No significant difference was found in the occurrence of headache among these groups.

Discussion

ISB stands out as a dependable and frequently used anesthetic approach for upper extremity procedures, offering the advantage of reduced opioid consumption and associated adverse effects. Similarly, LIA has proven to be a safe and effective method for pain management during knee and hip surgeries. In our study, patients who received ISB and LIA showed significantly lower rates of back pain compared to those undergoing EA, suggesting that ISB and LIA may offer better outcomes in alleviating back pain during orthopedic surgeries. Research by Andersen et al. has demonstrated that LIA provides superior pain control with fewer adverse effects compared to EA in total knee arthroplasty. Another study also showed that LIA is more effective in pain management during total knee arthroplasty. These findings underscore the potential effectiveness of LIA and ISB in relieving various types of pain, including back pain, throughout the perioperative period of orthopedic surgery. However, while LIA was found to play a significant role in alleviating headache during this period, no statistically significant difference was observed compared to other methods. Further investigation with larger sample sizes may be necessary to confirm these observations. Although our study is the first to compare the effects of different anesthesia methods on orthopedic surgery complications, it has certain limitations. Firstly, due to incomplete data in some studies, adjustments for concomitant variables were not feasible, potentially impacting the study outcomes. Additionally, subgroup analysis was not conducted. Secondly, the nature of ADDIS software may have influenced the calculation of pooled effect sizes. Lastly, some complications, such as headache and back pain, were not consistently reported across all anesthesia methods, which may introduce bias into our study findings.

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Conclusion:

- NBA appears to have benefits in reducing PONV, urine retention, and sore throat compared to other anesthesia methods during orthopedic surgery.
- The findings suggest that NBA may lead to better outcomes for patients undergoing orthopedic surgery.
- Previous research also supports the advantages of nerve blocks in reducing adverse events and improving pain relief in orthopedic procedures.

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