ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 10, Issue – 4, July – 2025, Page No. : 164 – 171

The Comparison of the Effect of Dexmedetomidine and Lignocaine on Hemodynamic and Recovery Responses during Tracheal Extubation: A Prospective Randomized Double-Blind Comparative Study

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Citation this Article: Dr. Gowham Murugesan, Dr. Upendra Kumar, Dr. Satheeshkumar M., "The Comparison of the Effect of Dexmedetomidine and Lignocaine on Hemodynamic and Recovery Responses during Tracheal Extubation: A Prospective Randomized Double-Blind Comparative Study", IJMSIR - July – 2025, Vol – 10, Issue - 4, P. No. 164 – 171.
Type of Publication: Original Research Article
Conflicts of Interest: Nil

Abstract

Background: Attenuation of hemodynamic fluctuations and a smooth recovery are major goals in anesthesia practice, especially at the time of tracheal extubation. Dexmedetomidine, a selective α_2-adrenoceptor agonist, has been investigated for its ability to decrease sympathetic outflow and maintain hemodynamic stability at the time of emergence from anesthesia. Lignocaine, a commonly used local anesthetic, also possesses potential advantages in minimizing airway reflexes. The purpose of this study was to compare the hemodynamic and recovery responses of dexmedetomidine and lignocaine during tracheal extubation.

Methods: Research investigators conducted a prospective randomized double-blinded study on 100 patients from among those requiring laparoscopic abdominal surgery with ASA I–II who were aged 20–45. Two separate groups consisting of n=50 patients received random distribution before study commenced. The subjects in Group D received a dexmedetomidine infusion at 0.75 μg/kg through 100 mL normal saline which continued for 15 minutes before extubation. The medical workers in Group L received a bolus injection of 1.5mg/kg lignocaine via intravenous route before performing extubation. Multiple measurements included heart rate and systolic/diastolic blood pressure along with mean arterial pressure among the studied patients. Researchers assessed both extubation success and emergence agitation together with recorded any adverse effects after surgery.

Results: The two groups matched in all statistics about demographic characteristics. The administration of dexmedetomidine produced substantially lower heart rate as well as systolic blood pressure and diastolic blood pressure and mean arterial pressure after extubation compared to lignocaine administration ($p < 0.001$). Within the dexmedetomidine treatment group both extubation quality scores and emergence agitation scores were reduced while bradycardia incidence showed a minimal rise. The number of vomiting episodes was

higher in the lignocaine group although they experienced fewer bradycardic incidents.

Conclusion: Dexmedetomidine better suppressed the hemodynamic response and ensured better extubation quality and lower agitation scores than lignocaine, with a slightly higher incidence of bradycardia. Dexmedetomidine can be regarded as an effective choice in patients who need stable hemodynamics and smooth emergence

Keywords: Dexmedetomidine, Lignocaine, Hemodynamics, Extubation, Recovery, Randomized Study

Introduction

Endotracheal extubation is a critical phase of anesthesia when significant hemodynamic alterations and airway reflexes can occur, threatening patient safety and comfort[1]. Tachycardia, hypertension, and respiratory complications with coughing or bucking on the endotracheal tube are common unless predicted and managed. The aim during this time is to minimize sympathetic bursts and ensure smooth, controlled emergence[2]. A number of pharmacologic approaches have been proposed, including the use of local anesthetics, sedatives, and opioids, to inhibit these undesirable responses [3].

Dexmedetomidine functions as a highly selective α2-adrenoceptor activator to deliver sedative and blood pressure-lowering impacts which diminish pressure on the airway procedures (source 4). The medication reduces norepinephrine release through brain receptors to control blood pressure during recovery time [5]. At lower doses patients maintain cooperation and respond to speech commands because of the sedatives effects in dexmedetomidine mode. The specific drug form enhances patient security by promoting peaceful rest with controlled blood flow.

Alternatively, lignocaine (lidocaine) is an established local anesthetic that can be administered intravenously at subanesthetic doses to inhibit cough reflexes and moderate sympathetic activity [7]. Mechanistically, it acts by blocking sodium channels and partially inhibiting airway reflexes, which can decrease the risk of coughing, laryngospasm, or bronchospasm during extubation. Lignocaine also possesses some analgesic effects that can be useful in the period around extubation [8]. Still, the hemodynamic advantages might be less significant in comparison to an effective α_2 agonist.

With such pharmacologic properties, it becomes clinically important to compare directly whether dexmedetomidine versus lignocaine is more capable of producing smoother recovery and dampening hemodynamic variability. Although both drugs have been investigated alone in the context of endotracheal extubation, data comparing head-to-head both drugs in one, prospective, randomized, and double-blind protocol is comparatively lacking. The current research therefore intends to study and compare the effectiveness of dexmedetomidine and lignocaine on hemodynamic stability, emergence profiles, and any side effects of the medication in patients who are undergoing endotracheal intubation during short-duration laparoscopic abdominal surgeries.

Through clarification of these two agents' comparative performance, anesthesia care professionals are able to make more confident decisions when controlling patients who possess differing perioperative risk categories. Moreover, patient comfort with minimized hemodynamic distress and complication avoidance supports further development of knowledge into which is best for utilization within this valuable period of extubation.

Materials And Methods

Study Design and Setting

Researchers ran a double-blind randomized study in the Anesthesiology Department of Jhalawar Medical College & Attached Hospitals during January 2023 and December 2023. Our research received approval from the Institutional Ethical Committee and our patients signed written permission to participate in the study.

Participants

100 patients of either sex, aged 20–45 years, of ASA physical status I–II, and undergoing elective laparoscopic abdominal surgeries under general anesthesia were included. The inclusion criteria also demanded a surgery time of less than 90 minutes. Excluded were patients with cardiovascular, respiratory, renal, or liver disease, uncontrolled diabetes or hypertension, obesity (BMI > 30), difficult airway (Cormack & Lehane grade 3 or 4), or history of sleep apnea.

Randomization and Blinding

Randomization of patients was accomplished with a sealed-envelope method into two equivalent groups (each n=50). Group allocations were hidden in similar envelopes that were opened by a third party independent of study measurements. The patients and the main anesthesiologist accountable for data collection were blinded to group assignment.

Interventions

- **Group D (Dexmedetomidine):** Received an infusion of 0.75 μg/kg dexmedetomidine in 100 mL 0.9% sodium chloride over 15 minutes prior to the anticipated time of extubation.
- **Group L (Lignocaine):** Received 1.5 mg/kg preservative-free 2% lignocaine as an IV bolus two minutes before extubation.

Anesthetic Protocol

All patients received standard IV medications before their procedure which included glycopyrrolate (0.2 mg), midazolam (1 mg), ranitidine (50 mg) and metoclopramide (4 mg). The staff connected four monitoring devices to the patient in the operating room to measure heart activity and blood pressure along with blood oxygenation and carbon dioxide levels. At the same time they delivered 100% oxygen for three minutes through a mask.

The surgeons administered fentanyl at 2 μg/kg and vecuronium at 0.1 mg/kg alongside propofol (2 mg/kg) to facilitate proper endotracheal intubation. The doctors maintained anesthesia by combining nitrous oxide and oxygen with sevoflurane from 0.2% to 1% and gave vecuronium intravenously at 0.03 mg/kg throughout the procedure. Doctors kept the amount of CO2 gas at the end of each breath between 35 and 40 millimeters of mercury. The patient received normal saline and Ringer's lactate fluid treatments as part of regular medical procedure.

Both groups ended their sevoflurane use right before taking off the tube. The patients received their assigned medication of either dexmedetomidine or lignocaine based on their study group. Our team checked for proper natural breathing patterns and airway reactions before starting glycopyrrolate and neostigmine to reverse the muscle relaxant effect. The patient's tubes were removed once their mental state showed they fully understood verbal instructions.

Outcome Measures

Researchers checked blood pressure, heart rate, mean arterial pressure and other vital hemodynamic readings right after baseline assessment and throughout the experiment until 30 minutes post-extubation. Experimenters evaluated three metrics which included

the Extubation Quality Score (five-point) and Emergence Agitation Score (six-point). The research team documented and treated standard complications like desaturation, laryngospasm, bronchospasm, vomiting, bradycardia, and hypotension.

Statistical Analysis

Data were summarized in a standard pro forma. Quantitative variables were reported as mean ± standard deviation and compared by the unpaired t-test. Qualitative data were compared using the chi-square test. $p < 0.05$ was used to consider an item statistically significant, while $p < 0.001$ was used to consider an item highly significant. Statistical packages utilized included Microsoft Office Excel 2010 and GraphPad Prism 6.05.

Results

A total of 100 patients were eligible and completed the study. Both groups (n=50 in each) were well matched for demographic variables such as age and sex distribution. None of the patients were lost to follow-up or excluded post-randomization. The main findings are as follows.

General Findings (Narrative Overview)

Hemodynamic monitoring showed that Group D (dexmedetomidine) patients had uniformly lower mean heart rate and arterial pressures at extubation and at all subsequent post-extubation intervals when compared to Group L (lignocaine). Extubation was smoother in Group D, as shown by a better (lower) extubation quality score. Emergence agitation was significantly reduced in the dexmedetomidine group. Although bradycardia was more common in Group D, it was easily controllable with routine measures (e.g., atropine). The recipients of lignocaine had a slightly higher rate of vomiting, but there were no serious complications in either group.

Paragraph Detailing Key Hemodynamic Outcomes

All baseline measures were similar for the two groups ($p > 0.05$). Following administration of study drugs and in the critical tracheal extubation period, Group D had a superior hemodynamic pattern with statistically lower systolic blood pressure, diastolic blood pressure, mean arterial pressure, and heart rate ($p < 0.001$). This was sustained into the immediate postoperative period, implying that dexmedetomidine has a sustained sympatholytic effect. Blunting of the stress response in Group D was evident as the patients had minimal fluctuations, which was in contrast to Group L, where there were transient peaks in heart rate and blood pressure.

Paragraph Detailing Extubation Quality and Emergence Agitation

Emergence agitation and extubation quality scores were significantly improved in the dexmedetomidine group. More than 80% of Group D patients received a score of 1–2 on the quality of extubation scale, representing smooth extubation with little coughing or movement. In comparison, in Group L, more patients received a score of 2–3. In emergence agitation, the dexmedetomidine group had very little agitation or restlessness, whereas the lignocaine group had a smaller percentage of patients with moderate agitation.

Tables

Table 1: Distribution of Cases by Sex

Sex	Group D (n=50)	Group L (n=50)
Female	29 (58%)	27 (54%)
Male	21 (42%)	23 (46%)

Table 2: Comparison of Heart Rate (bpm) at Extubation

Time Point	Group D (Mean ± SD)	Group L (Mean ± SD)	p-value
During Extubation	90.06 ± 5.80	103.16 ± 6.08	<0.001 (S)
1 min Post-Extubation	91.30 ± 5.64	100.98 ± 6.35	<0.001 (S)
10 min Post-Extubation	79.42 ± 3.68	90.51 ± 4.48	<0.001 (S)
30 min Post-Extubation	64.76 ± 3.77	74.88 ± 4.29	<0.001 (S)

Table 3: Extubation Quality Score

Score	Group D (n=50)	Group L (n=50)
1	8	0
2	33	11
3	9	39
4	0	0
5	0	0

Table 4: Side Effects

Side Effect	Group D (n=50)	Group L (n=50)
Vomiting	2	4
Respiratory Depression	0	0
Laryngospasm	0	0
Bronchospasm	0	0
Bradycardia	7	2
Hypotension	0	0

Discussion

The current study emphasizes that dexmedetomidine offers substantial hemodynamic stability and more gentle extubation compared with intravenous lignocaine in patients subjected to short-term laparoscopic abdominal operations. The attenuated heart rate and blood pressure seen in the dexmedetomidine group on and off extubation are consistent with earlier studies documenting the drug's centrally mediated sympatholytic properties[9]. Conversely, though lignocaine is efficacious in the suppression of airway reflexes and cough, its effect on cardiovascular parameters is seemingly less dramatic[10,11].

An important area of peri-extubation care is the management of coughing, bucking, or agitation since such incidents can trigger elevated intracranial and intraocular pressures or induce cardiovascular instability in susceptible patients [12,13]. Our results show that dexmedetomidine reduces these undesirable responses better than lignocaine. In addition, the emergence agitation scores reflected that wake-up was more peaceful and cooperative in patients treated with dexmedetomidine. Dexmedetomidine's atypical sedation profile, preserving arousability with an intense analgesic element and anxiolysis, has been suggested as an explanation[14,15].

In spite of these benefits, bradycardia was found more frequently with dexmedetomidine in our study group. This effect is consistent with α_2-adrenoceptor agonism, which can result in reduced sympathetic tone and enhanced vagal activity [16]. Nonetheless, all episodes of

bradycardia were self-limiting and responded well to the administration of atropine. In contrast, the lignocaine group had a slightly increased incidence of nausea and vomiting, consistent with earlier findings that intravenous lignocaine may not possess any serious antiemetic effects [17,18]. Importantly, neither agent resulted in clinically significant respiratory depression, hypotension, laryngospasm, or bronchospasm, highlighting their relative safety profiles in ASA I–II patients for short procedures.

Practically, the study implies that dexmedetomidine may be specifically useful for patients requiring strict hemodynamic control of blood pressure swings and those who would value a smooth and tranquil emergence profile. Clinicians should nonetheless be alert for bradycardia and be ready to treat it if it develops. Lignocaine continues to be an inexpensive option, particularly where mild blunting of airway reflexes is the principal objective, but its hemodynamic benefit may be weaker.[19,20]

In summary, our findings corroborate the growing body of evidence favoring dexmedetomidine as an agent of choice for stable emergence from general anesthesia, while also emphasizing the importance of monitoring potential bradycardic events. Future studies could expand on these findings by examining different dosing regimens, varying patient populations, or the addition of other adjuvant drugs. [21,22]

Conclusion

In this double-blind, prospective, randomized trial between dexmedetomidine and lignocaine during endotracheal extubation, dexmedetomidine proved to offer better hemodynamic stability and extubation quality. The overall emergence profile was less agitated with lower agitation scores, but bradycardia occurred more often. Lignocaine suppressed airway reflexes satisfactorily but was less effective on hemodynamic changes. These findings indicate that dexmedetomidine is a useful alternative in clinical situations where minimizing hemodynamic instability and providing a smooth recovery are of utmost importance, albeit with cautious monitoring for bradycardia.

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