Original Article

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Comparing the efficacy of adrenaline, clonidine, and dexmedetomidine in enhancing local anesthesia for impacted third molar extraction: a randomized controlled trial

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Background: In human dentition, the most commonly impacted teeth are the mandibular third molars (M3M). The removal or extraction of these teeth often causes anxiety in patients due to the perceived pain involved in the process. Therefore, pain must be effectively managed using anesthesia. The use of newer local anesthetic drugs can help minimize side effects and drug interactions. Traditionally, adrenaline is used as a vasoconstrictor along with lignocaine. When combined with lignocaine, the alpha agonists dexmedetomidine and clonidine can extend the duration of anesthesia, thereby reducing the need for additional pain-relieving medications.

Methods: This study used a randomized, triple-blind, parallel-arm design. Sixty patients were screened, and 45 systemically healthy patients requiring unilateral surgical removal of impacted mandibular third molars with similar difficulty (moderate-to-difficult according to the Modified Pederson's Index) were included in the study. Patients were allocated into three groups as follows: Group A: 2% Lignocaine Hydrochloride with 1:100,000 Adrenaline, Group C: 2% Lignocaine Hydrochloride with 15 μg/mL Clonidine, and Group D: 2% Lignocaine Hydrochloride with 1 μg/mL Dexmedetomidine. The evaluated parameters were the time of onset of anesthesia, depth of anesthesia, hemodynamic parameters, and duration of postoperative analgesia.

Results: Group D had a faster onset of action and prolonged duration of postoperative analgesia compared with Groups A and C. No statistically significant differences were observed between the three groups in terms of the depth of anesthesia and hemodynamic parameters.

Conclusion: Group D exhibited a significantly more rapid onset of anesthesia than Groups A and C, and the postoperative analgesic effect in Group D was significantly prolonged (7.22 hours) compared with that in Groups A (4.54 hours) and C (2.1 hours). Patients receiving the Group D solution experienced an extended period of comfort without the need for analgesics for up to 7.22 hours post-procedure.

Keywords: Analgesia; Duration; Hemodynamic Parameters; Impacted Tooth; Local Anesthesia; Mandible; Onset Time; Pain Management; Postoperative Pain; Third Molar.

INTRODUCTION

The prevalence of impacted mandibular third molars is high globally, and this issue is a common occurrence in dental practice [1]. Surgical removal of these molars can lead to complications such as pain, swelling, and difficulty opening the mouth [2]. Local anesthetics play a crucial role in dental pain management by blocking pain signals to the central nervous system.

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Lignocaine combined with adrenaline is widely considered the leading local anesthetic used in dental practice. Adrenaline affects both alpha- and beta-adrenergic receptors, with particularly strong activation of alpha receptors. This activation causes vasoconstriction and increased vascular permeability in cases of anaphylaxis, preventing the loss of intravascular fluid volume and hypotension. The action of adrenaline on alpha receptors also relaxes the bronchial and iris smooth muscles, acting as a histamine antagonist and alleviating allergic reaction symptoms. In addition, adrenaline increases the blood sugar levels and promotes hepatic glycogenolysis.

By stimulating beta-adrenergic receptors, adrenaline induces bronchial smooth muscle relaxation, providing relief from bronchospasm, wheezing, and dyspnea associated with anaphylaxis. Despite its advantages, including local vasoconstriction to create a bloodless surgical field, adrenaline has inherent drawbacks. Excessive doses can lead to adverse effects such as tachycardia and hypertension, requiring caution, especially in patients with diabetes, hypertension, and cardiac disease.

Consequently, efforts have been made to identify a safer adjunct to lignocaine that enhances its anesthetic efficacy while minimizing side effects. Dexmedetomidine has emerged as a potential substitute for adrenaline, with research indicating its non-toxic nature and potential neuroprotective effects when combined with local anesthesia [3,4].

Dexmedetomidine is an alpha-2 adrenoceptor agonist that selectively activates these receptors. By binding to presynaptic alpha-2 adrenoceptors, it blocks the release of norepinephrine, which plays a role in the transmission of pain signals. The activation of postsynaptic alpha-2 adrenoceptors reduces sympathetic activity, leading to decreased blood pressure and heart rate. These effects make dexmedetomidine valuable for anesthesia and sedation. It also exhibits neuroprotective properties and can alleviate postoperative pain without inducing cardiorespiratory depression [5].

Clonidine primarily functions as an alpha-2 adrenoceptor agonist, affecting blood pressure and heart rhythm. Upon binding to the alpha-2 adrenoceptor, clonidine induces changes in the alpha subunit of the G protein, thereby reducing its affinity for GDP and promoting the substitution of GDP with GTP. This process leads to the dissociation of the alpha subunit from the other subunits and its interaction with an effector.

The alpha-2 adrenoceptor is associated with G proteins Go and Gi, which inhibit adenylyl cyclase and activate potassium channels, resulting in hyperpolarization. The binding of clonidine to these receptors can also diminish the transmission of pain signals in the spinal cord. The sedative effects of clonidine may stem from its effects on alpha-2 adrenoceptors in the locus coeruleus, a brain region involved in regulating wakefulness. In addition, clonidine can influence blood pressure regulators in specific areas of the medulla oblongata. It stabilizes membranes and neurons and promotes the release of enkephalin-like compounds with a peripheral analgesic effect. Combining clonidine with short-acting local anesthetics can prolong the duration of anesthesia [6].

The primary objective of this study was to evaluate the efficacy of clonidine and dexmedetomidine in comparison to adrenaline as additives to local anesthesia. This study systematically examined the time of onset, depth of anesthesia, hemodynamic parameters, and postoperative analgesic outcomes after the extraction of impacted lower third molars.

METHODS

The present study was a prospective randomized controlled trial conducted on patients requiring surgical removal of impacted mandibular third molars between August 2022 and January 2024 at the Outpatient Department of Oral and Maxillofacial Surgery of the Shri Sharad Pawar Dental College and Hospital (SPDC), Datta Meghe Institute of Higher Education and Research (DMIHER), Sawangi (Meghe), Wardha. The study was conducted in accordance

with the principles of the Declaration of Helsinki and was approved by the Institutional Ethical Committee of Datta Meghe Institute of Medical Sciences (DMIMS) on February 15, 2022, with ethical approval number DMIMS (DU)/IEC/2022/776. The trial was also registered with the Clinical Trials Registry of India (CTRI) on June 24, 2022, with registration number: CTRI/2022/12/048281.

Sixty patients were screened, and 45 systemically healthy patients requiring unilateral surgical removal of impacted mandibular third molars with similar difficulty (moderate-to-difficult according to the Modified Pederson's Index) were included in the study (Fig. 1). The sample size was calculated using the SPSS 27 and GraphPad Prism 7 software. The inclusion criteria were as follows: individuals with American Society of Anesthesiologists (ASA) grade I status, aged between 18 and 40 years, and having impacted mandibular third molar with a moderate-to-difficult Modified Pederson's Index. Criteria for exclusion included a history of drug dependence, systemic diseases such as hypertension, diabetes mellitus, and immunocompromising conditions, allergy to local anesthetic agents, pregnancy, breastfeeding, use of oral contraceptives, presence of local infection, any signs of abscess, pus discharge, pericoronitis, pathologies associated with third molar teeth, congenital heart disease, and psychiatric illness. In addition, post-recruitment exclusion criteria included patients who experienced significant pain during the procedure as indicated by a Faces Pain Scale (FPS) score of 3 or higher, who received a rescue inferior alveolar nerve block with 2 mL of 2% lignocaine with 1:100,000 epinephrine and were excluded from further evaluation.

The preoperative evaluation included obtaining written informed consent, recording clinical history, and conducting a thorough clinical and radiological examination. Routine blood investigations (hemoglobin level, clotting time, bleeding time, and random blood sugar level) and orthopantomograms were performed. Patients were informed about the study protocol and the FPS score following the preoperative evaluation.

A simple randomization method was used to allocate the 45 patients into three groups (n=15 each):

- Group A: 2% Lignocaine Hydrochloride with 1:100,000 Adrenaline
- Group C: 2% Lignocaine Hydrochloride with 15 µg/mL Clonidine
- Group D: 2% Lignocaine Hydrochloride with 1 µg/mL Dexmedetomidine

The allocation was based on an electronically generated table of random figures, and the assignments were sealed in opaque envelopes. The allocation process did not consider age, sex, or type of impaction.

The study was triple-blind, with the administrator providing the local anesthetic solution, the patients, and the examiner being unfamiliar with the solution used. An independent researcher ensured randomization and prepared the local anesthesia. An intraoral local anesthetic solution was administered using the Fischer 1-2-3 technique for inferior alveolar nerve block (IANB).

For the lignocaine + clonidine solution, 9 mL of 2% lignocaine were mixed with 1 mL of a 150 µg/mL clonidine hydrochloride ampule in a 10 mL syringe. For the lignocaine + dexmedetomidine solution, 1 µg of dexmedetomidine hydrochloride was added to 1 mL of 2% lignocaine hydrochloride in an insulin syringe. The blood pressure and heart rate were monitored during the procedure. This study aimed to analyze the time of onset of action, depth of anesthesia, hemodynamic parameters, and postoperative analgesia following the removal of lower impacted third molars.

Procedure:

Patients were instructed to gargle with a betadine solution before the procedure. All nerve blocks and surgical procedures were performed by a single experienced surgeon. The IANB (1.8 mL) was administered using the Fischer 1-2-3 method. The success of the IANB was determined by the patient experiencing numbness along the course of the IAN, which was objectively verified using an atraumatic probe. Surgical extraction of the impacted lower third molar was performed and the surgical site was sutured with 3-0 black silk. Each patient received

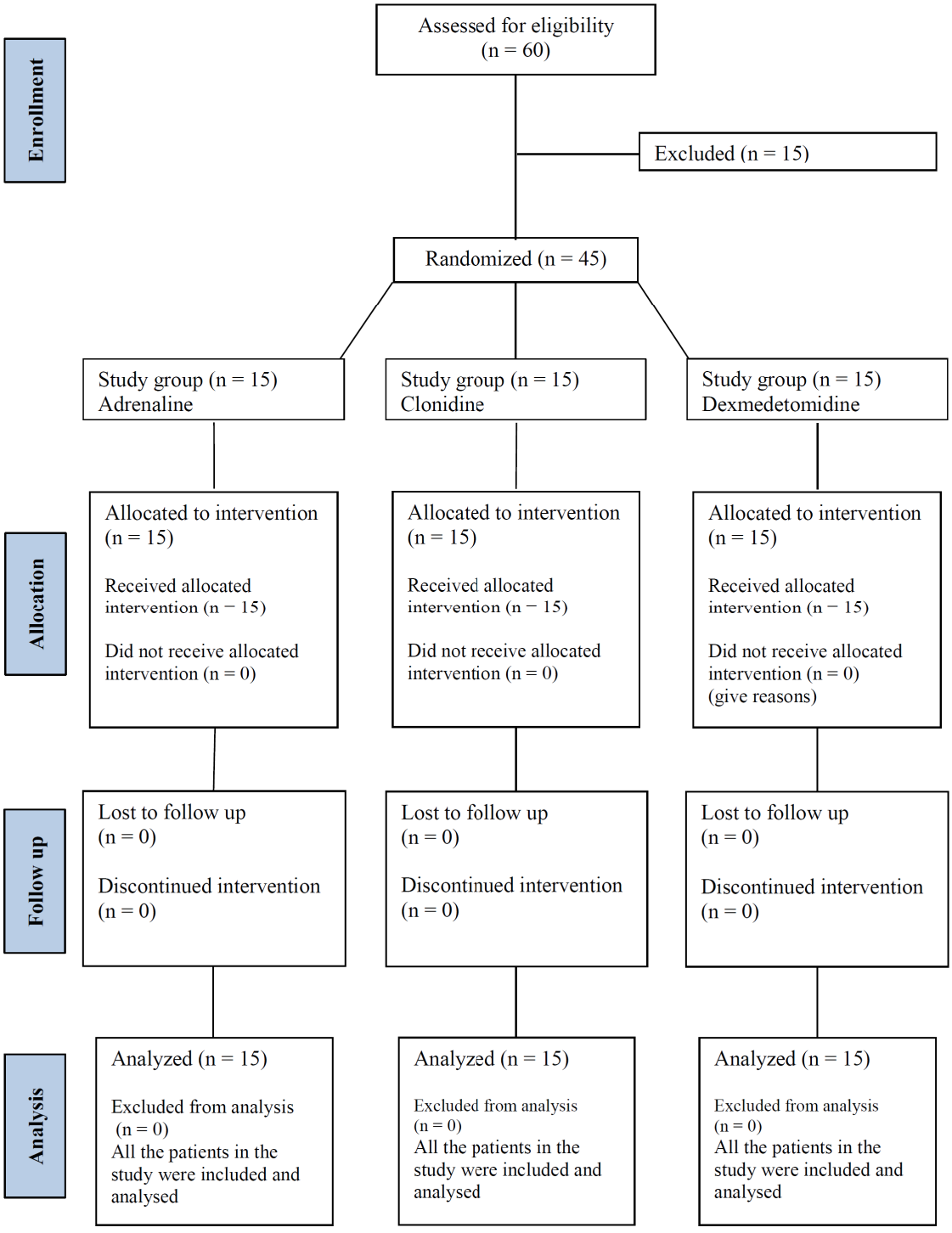

Fig. 1. Consolidated Standards of Reporting Trials (CONSORT) flow diagram.

standard postoperative instructions and was advised not to take any analgesics until they experienced a pain score ≥ 3 on the FPS as the anesthesia of the lower lip wore off completely. The patients were prescribed amoxicillin (500 mg capsules) three times daily for three days and aceclofenac (100 mg tablets) twice daily for three days.]The evaluation parameters were as follows: onset of anesthesia (latency), i.e., the time from the deposition of

Table 1. Search strategy for electronic databases

Age group (yrs)	Group A	Group C	Group D	χ_2^2-value
21-30 yrs	8 (53.33%)	9 (60%)	10 (66.67%)	0.55 P = 0.75, NS
31-40 yrs	7 (46.67%)	6 (40%)	5 (33.33%)	
Total	15 (100%)	15 (100%)	15 (100%)	
Mean ± SD	30.73 ± 6.50	31.13 ± 4.89	30 ± 4.45	
Range	21-39 yrs	25-39 yrs	22-38 yrs	

NS, not significant; SD, standard deviation.

Table 2. Distribution of patients in the three groups according to their sex (chi-square test)

Gender	Group A	Group C	Group D	χ_2^2-value
Male	8 (53.33%)	10 (66.67%)	5 (33.33%)	3.37 P = 0.18, NS
Female	7 (46.67%)	5 (33.33%)	10 (66.67%)	
Total	15 (100%)	15 (100%)	15 (100%)	

NS, not significant.

the solution to the onset of the first symptom of anesthesia, measured at 30-second intervals using a digital stopwatch; depth of anesthesia (profoundness), determined by assessing the severity of pain experienced during specific surgical events and recorded each time and every 30 minutes up to 120 minutes thereafter, and measured using a 10-unit FPS; and hemodynamic parameters, including non-invasive blood pressure (NIBP) measurement of systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate measured using a pulse oximeter. The duration of postoperative analgesia was also measured from the conclusion of the surgical procedure until the pain intensity score of the patient reached or exceeded 3 on the FPS and the patient required a rescue analgesic, which marked the end of the study.

The patients were instructed to provide feedback on their pain intensity using the FPS during telephonic conversations every 30 minutes after experiencing the first bout of postoperative pain. This process allowed for the continuous assessment of pain intensity and the duration of postoperative analgesia.

The study was conducted as a triple-blind trial, with the administrator injecting the local anesthetic solution, the subjects, and the examiner unfamiliar with the mixture being used. An independent researcher oversaw the randomization and preparation of the local anesthesia. One-way analysis of variance (ANOVA) and Multiple Tukey tests were used to compare parameters between the three groups.

RESULTS

Table 1 indicates that out of 27 patients aged 21-30 years, Group A comprised 8 patients (53.33%), Group C had 9 patients (60%), and Group D included 10 patients (66.67%). Additionally, out of 18 patients aged 31-40 years, Group A comprised 7 patients (46.67%), Group C had 6 patients (40%), and Group D included 5 patients (33.33%) (P = 0.75).

Table 2 indicates that out of 45 patients, 23 were male (51.11%), of whom Group A comprised 8 patients (53.33%), Group C had 10 patients (66.67%), and Group D included 5 patients (33.33%). Additionally, 22 patients were female (48.88%), of whom Group A comprised 7 patients (46.67%), Group C had 5 patients (33.33%), and Group D included 10 patients (66.67%) (P = 0.18). Out of 45 Patients, 23 were male (51.11%) and 22 were female (48.88%).

The mean time of onset of anesthesia in patients in the adrenaline group was 147.06 ± 41.59 seconds, compared with 201.66 ± 17.99 seconds in the clonidine group and 120.13 ± 9.25 seconds in the dexmedetomidine group. The onset of anesthesia was fastest when the anesthetic solution was administered in Group D, followed by Group A, and then Group C. These results

Table 3. The onset of anesthesia in the three groups

Group	Mean	SD	F-value	Multiple comparison : Tukey test		
				Group A vs Group C	Group A vs Group D	Group C vs Group D
Group A	147.06	41.59	36.29 P=0.0001, S	0.0001, S	0.023, S	0.0001, S
Group C	201.66	17.99				
Group D	120.13	9.25				

S, significant; SD, standard deviation.

Table 4. The depth of anesthesia was evaluated by measuring pain intensity scores using the Faces Pain Scale (FPS) during specific stages of the procedure (incision, flap reflection, bone guttering, and tooth/root sectioning)

Pain intensity score	Group A	Group C	Group D
Incision	0 (0%)	0 (0%)	0 (0%)
Flap reflection	0 (0%)	0 (0%)	0 (0%)
Bone guttering	0 (0%)	2 (13.33%)	0 (0%)
Tooth/root sectioning	0 (0%)	2 (13.33%)	0 (0%)

Table 5. After administering the anesthetic injection, heart rate was assessed during and after the procedure at baseline and 15, 30, 60, 90, and 120 minutes later

Time interval (in minutes)	Group A (Lignocaine + Adrenaline)		Group C (Lignocaine + Clonidine)		Group D (Lidocaine + Demedetomidine)		F-value	P-value
Heart rate (beats/min)	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Baseline	77.20	7.04	76	6.41	71.89	6.02	2.77	0.74, NS
15 minutes	74.53	3.33	76.13	5.04	73.86	3.15	1.31	0.28, NS
30 minutes	76.13	3.73	76	3.46	75.60	3.04	0.09	0.90, NS
60 minutes	76.80	4.26	80.26	4.94	77.86	4.03	2.40	0.10, NS
90 minutes	74.53	4.80	76.66	4.87	74.66	4.45	0.96	0.39, NS
120 minutes	76	2.82	76.26	3.45	76	3.54	0.03	0.96, NS

NS, not significant.

Table 6. After administering the anesthetic injection, systolic blood pressure was assessed during and after the procedure at baseline and 15, 30, 60, 90, and 120 minutes later

Time interval (in minutes)	Group A (Lignocaine + Adrenaline)		Group C (Lignocaine + Clonidine)		Group D (Lidocaine + Dexmedetomidine)		F-value	P-value
Systolic blood pressure (mmHg)	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Baseline	116.40	8.45	112.80	6.49	119.60	8.69	2.75	0.75, NS
15 minutes	114.80	5.89	114.53	7.50	117.06	5.99	0.68	0.50, NS
30 minutes	114.13	7.18	113.60	6.89	112.53	6.34	0.21	0.80, NS
60 minutes	114	7.36	116.66	6.53	114.93	7.62	0.53	0.59, NS
90 minutes	117.33	5.74	114.80	6.79	115.33	6.21	0.68	0.51, NS
120 minutes	114.40	6.55	114.26	6.18	114.93	7.40	0.04	0.96, NS

NS, not significant.

were statistically significant (f = 36.29, P = 0.001). Specifically, Group D had the fastest onset of anesthesia at 120.13 ± 9.25 seconds, followed by Group A at 147.06 ± 41.59 seconds, and then Group C at 201.66 ± 17.99 seconds (Table 3).

The depth of anesthesia was evaluated by measuring pain intensity scores using the FPS during specific stages of the procedure (incision, flap reflection, bone guttering, and tooth/root sectioning). Statistical analysis revealed that the dexmedetomidine and adrenaline solutions (Groups D and A) were equally effective in achieving sufficient depth of anesthesia. However, significant

Table 7. After administering the anesthetic injection, diastolic blood pressure was assessed during and after the procedure at baseline and 15, 30, 60, 90, and 120 minutes later

Time interval (in minutes)	Group A (Lignocaine + Adrenaline)		Group C (Lignocaine + Clonidine)		Group D (Lidocaine + Demedetomidine)		F-value	P-value
Diastolic blood pressure (mmHg)	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation		
Baseline	73.06	6.18	74.80	6.53	77.46	6.86	1.72	0.19, NS
15 minutes	74	4.07	75.46	4.92	72.26	5.11	1.72	0.19, NS
30 minutes	72.53	7.61	73.33	6.07	73.86	5.37	0.16	0.84, NS
60 minutes	71.86	5.47	73.20	7.08	71.86	6.90	0.20	0.81, NS
90 minutes	71.86	4.68	72.40	7.52	73.33	5.21	0.23	0.79, NS
120 minutes	73.86	4.10	73.33	6.83	72.93	3.45	0.13	0.87, NS

NS, not significant.

Table 8. The duration of postoperative analgesia was recorded after the pain score of the patient reached a level of 3 or higher on the Faces Pain Scale (FPS) or when the patient took an analgesic postoperatively, marking the endpoint of the study

Group	Mean (hours)	SD	F-value	Multiple comparison : Tukey test		
				Group A vs Group C	Group A vs Group D	Group C vs Group D
Group A	4.54	0.38	35.94 P = 0.0001, S	0.0001, S	0.0001, S	0.0001, S
Group C	2.1	0.38				
Group D	7.22	0.56				

S, significant; SD, standard deviation.

discomfort was observed in four patients in Group C during bone guttering and tooth/root sectioning (Table 4).

After administering the anesthetic injection, hemodynamic parameters such as heart rate and blood pressure were assessed during and after the procedure at baseline and 15, 30, 60, 90, and 120 minutes later. No significant changes in these parameters were observed following the administration of any of the three solutions ($P > 0.05$) (Tables 5-7).

The duration of postoperative analgesia was recorded after the pain score of the patient reached a level of 3 or higher on the FPS or when the patient took an analgesic postoperatively, marking the endpoint of the study. The duration of postoperative analgesia was the longest in Group D (7.22 hours), followed by Groups A (4.54 hours) and C (2.1 hours). These differences were statistically significant ($P = 0.001$). The results revealed that Group D provided postoperative analgesia for 3.5 times longer than Group C and twice as long as Group A (Table 8).

DISCUSSION

After tooth extraction, postoperative pain is typically moderate to severe and can cause significant discomfort for patients [7]. Managing pain after third molar surgery has been a challenge for oral surgeons because of the variability in the inflammatory response [8]. Inadequate postoperative pain control can lead to clinical and psychological changes and is associated with numerous negative consequences.

Local anesthetics are essential for pain control in dentistry. A continuous drive persists in the field of dentistry to develop newer and safer local anesthetic agents and adjuvants with enhanced efficacy, potency, and handling properties [9]. In recent times, various drugs have been used as adjuncts to local anesthetics, including vasoconstrictors, opioids, alpha-2 agonists, bicarbonates, ketamine, magnesium, and others.

Dexmedetomidine demonstrates specific and selective alpha-2 adrenoceptor agonism. When used as an adjunct

to local anesthetics, it reduces the latency period and extends the duration of local anesthesia. Moreover, it can decrease the systemic side effects that may arise from higher doses of local anesthetics. Additionally, dexmedetomidine has been linked to the induction of hemostasis, potentially aiding surgical operability for surgeons and enhancing patient satisfaction.

Clonidine is an alpha-2 adrenergic agonist with dual central and peripheral actions that reduce anxiety. Centrally, it stimulates the presynaptic alpha-2 adrenergic receptors, leading to decreased blood pressure and mild sedation. The peripheral analgesic effect is believed to contribute to the pain-relieving properties of clonidine. Clonidine is thought to stabilize neuronal membranes and affect neuronal activity to produce these effects. Some studies have explored the combination of clonidine with lignocaine for the treatment of neurological deficits and have found it to be effective in providing analgesia.

The present study used a randomized, triple-blind, parallel-arm design. Out of 45 patients, 23 were male (51.11%) and 22 were female (48.88%); Group A comprised 8 male patients (53.33%) and 7 female patients (46.67%), Group C had 10 male patients (66.67%) and 5 female patients (33.33%), and Group D included 5 male patients (33.33%) and 10 female patients (66.67%).

All 45 patients included in the study were aged between 18 and 40 years, with a mean age of 30.73 ± 6.50 years in Group A, 31.13 ± 4.89 years in Group C, and 30.00 ± 4.45 years in Group D. The patients were extensively informed about the procedure and study protocol. All 45 patients were also thoroughly educated regarding the FPS prior to the start of the procedure.

The time of onset of anesthesia (latency) of a drug depends on pKa value (dissociation constant); the lower the pKa value, the shorter the time of onset. The rapid onset of action in Group D compared with that in Groups A and C ($P < 0.05$) can be attributed to their different pKa values. Dexmedetomidine has a pKa value of 7.1 which is close to the physiological pH value of 7.4, thereby increasing the ionized fraction and enabling quicker penetration into nerves; in contrast, the adrenaline and clonidine solutions have pKa values of 8.52 and 8.16 respectively. This discrepancy demonstrates the reason behind the rapid onset of action of the lignocaine anesthetic solution when dexmedetomidine is added. A shorter anesthetic latency indicates a more effective local anesthetic agent.

In the present study, the mean time of onset of anesthesia following the administration of the anesthetic solution was 147.06 ± 41.59 seconds in Group A, 201.66 ± 17.99 seconds in Group C, and 120.13 ± 9.25 seconds in Group D. The onset of action after administration was more rapid in Group D than in Groups A and C, with the difference being statistically significant ($P = 0.023$ and $P = 0.0001$, respectively). In addition, Group A had a faster onset of action than Group C with statistical significance.

In the present study, Group D had a more rapid onset of anesthesia than Group A. This result was in concordance with that of a previous study [10] in which patients with bilateral symmetrical impacted third molars received either 2% lignocaine with dexmedetomidine 1μg/mL (Group D) or 2% lignocaine in 1:80,000 adrenaline (Group A), and the results showed that the onset of action of the local anesthesia was significantly faster in Group D than in Group A ($P < 0.001$).

In the present study, Group D had a more rapid onset of anesthesia than Group C. This result was in concordance with that of a previous study [11] in which a meta-analysis of 14 clinical studies regarding the supraclavicular brachial plexus block was performed and showed that perineural dexmedetomidine had a faster onset of action (both sensory and motor) than perineural clonidine, and the difference was statistically significant ($P < 0.001$). Similarly, the present study is also in accordance with another existing study [12] regarding intravenous regional anesthesia which compared two groups: Group C receiving 40 mL of 0.5% lignocaine (preservative-free) + clonidine 1 μg/kg, and Group D receiving 40 mL of 0.5% lignocaine (preservative-free) + dexmedetomidine 1 μg/kg. In this study, Group D again exhibited a more rapid onset of anesthesia than Group C.

In contrast, a different study [13] showed no statistically significant difference in time of onset of anesthesia between Group C (120.0 ± 8.2 seconds) and Group A (106.0 ± 8.2 seconds) and the authors stated that clonidine was equally as efficient as adrenaline in regard to onset of anesthesia. This contradicts the results of the present study, which showed that Group A had a significantly more rapid onset of anesthesia than Group C.

The addition of sympathomimetic drugs to local anesthetic agents not only reduces toxicity but also enhances the potency and depth of anesthesia, which leads to a pain-free surgical procedure. In the present study, Groups A and D were equally potent and offered similar quality in depth of anesthesia. This was in accordance with a previous study [10] in which the pain threshold was noticeably increased following the injection of lignocaine plus dexmedetomidine solution when compared with lignocaine plus adrenaline, but the difference was not statistically significant ($P < 0.0001$).

A study from 1992 [14] included 33 patients who underwent axillary brachial plexus blocks with either 50 mcg of clonidine or 200 mcg of adrenaline added to 1% lignocaine. The results showed that patients reported higher pain scores with clonidine, which is in accordance with the present study, in which four patients receiving lignocaine with clonidine experienced pain and discomfort.

The administration of the adjuvant temporarily affects the arterial blood pressure and heart rate. Both of these hemodynamic parameters vary during stressful situations. In the present study, no statistically significant difference was observed between Groups A and D in regard to heart rate, SBP, and DBP at specific intervals. This result was in accordance with that of a previous study [10] which showed similar findings for all three parameters.

In the present study, no statistically significant difference was observed between Groups C and D in regard to heart rate, SBP, and DBP at specific intervals. This result was in accordance with that of a previous study [15] in which patients undergoing transurethral resection of prostate or bladder tumors under spinal anesthesia received either 12 mg of bupivacaine supplemented with 3 mg of dexmedetomidine (Group D) or 12 mg of bupivacaine supplemented with 30 mg of clonidine (Group C).

An important consideration for the efficacy of the local anesthetic solution is its duration of action, which should not only be long enough to allow for the operative procedure to be completed but should also be able to provide prolonged postoperative analgesia.

In the present study, the duration of postoperative analgesia was 4.54 ± 0.38 hours in Group A, 2.1 ± 0.38 hours in Group C, and 7.22 ± 0.56 hours in Group D. The difference was statistically significant. ($P = 0.0001$), with Group D exhibiting prolonged postoperative analgesia in comparison with Groups A and C. This result suggests that Group D can provide 3.5 times longer postoperative analgesia than Group C and twice longer postoperative analgesia than Group A.

In the present study, Group D showed a longer duration of postoperative analgesia than Group A, which was in accordance with a previous study [16] that compared 2% lignocaine with 1 μg/dL dexmedetomidine (Group D) and 2% lignocaine with 1:2,00,000 adrenaline (Group A) in 25 dental patients.

Similarly, in the present study, Group D showed a longer duration of postoperative analgesia than Group C. This result was is in accordance with that of a previous study [17] regarding Bier blocks in upper limb orthopedic surgeries which showed that 1 mcg/kg of dexmedetomidine added to 0.5% lignocaine was more effective than 1 mcg/kg of clonidine added to 0.5 % lignocaine and provided better quality and longer duration of analgesia.

Although lignocaine and adrenaline remain the best combination for local anesthesia in dentistry, our exploration of dexmedetomidine and clonidine as potential substitutes has unveiled intriguing findings. Patients who received dexmedetomidine exhibited a faster onset of anesthesia than those in the other groups. Additionally, patients in the dexmedetomidine group experienced extended postoperative analgesic coverage lasting up to 7.2 hours, during which additional analgesics were unnecessary. This duration was 3.5 times longer

than that observed in the clonidine group and twice as long as that in the adrenaline group. In conclusion, this study suggests that dexmedetomidine holds promise as a viable alternative to adrenaline, offering both a rapid onset of anesthesia and prolonged postoperative analgesia, thereby potentially enhancing patient comfort and satisfaction with dental procedures.

Limitations:

There is a paucity of literature wherein the three groups used in the present study have been studied and compared in third molar surgeries. During the postoperative period, the analgesic and anesthetic effects gradually decrease, leading to an incremental increase in the perception of pain. In our assessment, we concentrated solely on pain as a singular sensation and did not consider other sensory perceptions like temperature, proprioception, and pressure.

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Anchal Agarwal: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing

CONFLICTS OF INTEREST: The authors have no conflicts of interest to declare.

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