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ORIGINAL ARTICLE

Age-related differences in functional and post-operative outcomes in spinal anesthesia for open appendectomy with Dexmedetomidine

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ABSTRACT

Keyword
Dexmeditomidine, ASA classification, Bromage score.
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Background: Dexmedetomidine , a selective α2 adrenergic agonist, preserves neurological function and mitigates neuronal damage. **Objectives:** This study examined age-related variations in the efficacy and postoperative outcomes of DEX in patients undergoing open appendectomy under spinal anesthesia. **Patients and Methods:** A prospective observational study was conducted on 74 patients receiving DEX perioperatively. Participants were stratified into four age groups: <20 years (n=12), 20-30 years (n=43), 30-40 years (n=8), and >40 years (n=11). **Results**: Intraoperative adverse events (e.g., bradycardia, hypotension) and postoperative outcomes (analgesia duration, VAS scores, Bromage score) showed no significant age-related differences. However, older patients exhibited higher ASA scores (P<0.001), indicating greater comorbidities. VAS scores at 1-hour post-surgery differed significantly (P=0.017), with younger patients reporting lower pain. **Conclusion:** While most outcomes were consistent across age groups, the disparity in ASA classification underscores the impact of aging-related comorbidities on perioperative management. The stability of intraoperative and postoperative parameters, including pain and sensory recovery, suggests Dexmeditomidine reliability as a therapeutic agent across diverse ages.

INTRODUCTION

Dexmedetomidine is a highly selective α2 adrenergic receptor agonist that maintains neurological function and reduces neuronal damage. It provides a protective effect against cognitive impairments by suppressing the hippocampus inflammatory response and neuronal apoptosis triggered by surgical trauma (1).

Dexmedetomidine sedation in the intensive care unit has demonstrated advantageous effects on sleep quality and minimal impacts on breathing. Scheduled intravenous injection of Dexmedetomidine postoperatively was shown to diminish in-hospital delirium (2).

Dexmedetomidine utilized for case-controlled analgesia (PCA) diminished discomfort and undesirable effects while enhancing case satisfaction post-surgery (3).

In elderly cases (aged sixty years or older) undergoing spinal surgery, intravenous and endotratracheal dexmedetomidine decreased the occurrence of early postoperative delirium in comparison to intranasal administration (4).
In pediatric patients undergoing surgery for congenital heart disease, dexmedetomidine was related to a shortened length of mechanical ventilation, diminished postoperative opioid use, attenuated stress response, & a decreased incidence of delirium in comparison to placebo or other anesthetics (5). Nonetheless, it may elevate the possibility of bradycardia and hypotension. In infants and toddlers with congenital heart disease, dexmedetomidine was effectively utilized as the principal sedative for invasive operations while preserving spontaneous respiration (6).
This study aimed to investigate how age influences the effectiveness and postoperative outcomes of using dexmedetomidine in patients undergoing open appendectomy surgery under spinal anethesia.

PATIENTS AND METHODS

This prospective, observational research has been conducted on 74 cases who received dexmedetomidine as part of their perioperative management. Patients were classified into four age groups: <20 years included 12 patients, 20-30 years included 43 patients, 30-40 years included 8 patients, and >40 years included 11 patients.

Inclusion Criteria: Cases aged eighteen years and older who had elective surgery and received dexmedetomidine for sedation and analgesia were included. All participants were scheduled for general anesthesia and had no history of allergies or adverse reactions to dexmedetomidine. Informed consent has been collected from all participants.

Exclusion Criteria: Cases with a known history of severe cardiovascular conditions (e.g., bradycardia, hypotension), renal or hepatic impairment, a history of chronic drug or alcohol abuse, or those who were pregnant or breastfeeding. Cases with a history of neurological disorders or cognitive impairment were also excluded from the study.

Ethical Considerations: The research has been performed in accordance with the Declaration of Helsinki, and ethical clearance has been secured from the institutional review board (IRB). All cases provided informed consent prior to their involvement in the research.

Methods

Intervention: All patients received dexmedetomidine as part of their perioperative care regimen. The drug was administered according to standard clinical practice guidelines, with doses adjusted depending on the individual case's clinical condition and response to therapy. Dexmedetomidine was administered intravenously either as a continuous infusion or bolus, as per the anesthesiologist's discretion.

Patient Stratification: Patients were stratified into four age groups for analysis:
Group 1: below twenty years
Group 2: twenty to thirty years
Group 3: thirty to forty years
Group 4: above forty years
Each group was assessed for intraoperative adverse events, postoperative analgesia, sensory recovery, and functional outcomes. Age-related differences in outcomes were the primary focus of the analysis.

Data Collection:

Demographic data: Age, sex, smoking history, and American Society of Anesthesiologists (ASA) physical status classification were recorded.

Intra-operative data: Operation time, incidence of adverse events (e.g., bradycardia, hypotension, nausea, vomiting, respiratory depression), and any interventions required have been documented.

Postoperative data: Duration of postoperative analgesia, time to sensation, and the Visual Analog Scale (VAS) scores for pain were recorded at specified intervals (1, 2, 4, 6, and 8 hours postoperatively). The Bromage score, which assesses motor block, was also recorded at 5 minutes, one hour, two hours, four hours, and six hours after surgery.

Outcome Measures:

Primary outcome: Age-related differences in functional and postoperative outcomes, including postoperative pain (VAS scores), motor block (Bromage score), and sensory recovery time.

Secondary outcomes: The prevalence of intraoperative adverse events, including bradycardia, hypotension, nausea, vomiting, and respiratory depression.

Statistical Analysis: The data have been examined utilizing suitable statistical techniques. Descriptive statistics (mean, standard deviation) have been utilized for continuous variables, while categorical data have been assessed utilizing chi-square or Fisher's exact tests. Comparisons among age groups have been conducted utilizing analysis of variance (ANOVA) or the Kruskal-Wallis test, where applicable. A p-value below 0.05 has been deemed statistically significant.

RESULTS

Table (1): Distribution of case's characteristics between age groups in Dexmedetomidine group.

	<20 years N = 12	**20-30 years N = 43**	**30-40 years N = 8**	**>40 years N = 11**	**P-value**
Sex					
Male	7 (58.3%)	21 (48.8%)	7 (87.5%)	7 (63.6%)	0.221
Female	5 (41.7%)	22 (51.2%)	1 (12.5%)	4 (36.4%)	
Smoking	0 (0%)	3 (7%)	2 (25%)	3 (27.3%)	0.07
ASA					
I	11 (91.7%)	40 (93%)	5 (62.5%)	3 (27.3%)	**<0.001**
II	1 (8.3%)	3 (7%)	3 (37.5%)	8 (72.7%)	
Operation time (min) Mean ±SD	51.67 ±2.77	52.72 ±2.85	53.13 ±1.46	53.64 ±4.18	0.443

P value >0.05: Not significant, P value <0.05 is statistically significant, p<0.001 is highly significant, SD: standard deviation, ASA: American Society of Anesthesiologists.

Table 1 demonstrates that there was statistically insignificant difference among age groups in the dexmedetomidine group regarding sex, smoking, and operation time, while there was a highly statistically significant difference among age groups in the dexmedetomidine group regarding ASA.

Table (2): Distribution of Intra-Operative Adverse events between age groups in Dexmedetomidine group.

	<20 years N = 12	**20-30 years N =43**	**30-40 years N =8**	**>40 years N =11**	**P-value**
Abdominal	2 (16.7%)	4 (9.3%)	0 (0%)	1 (9.09%)	0.667

discomfort					
Visceral pain	1 (8.3%)	5 (11.6%)	0 (0%)	2 (18.2%)	0.638
Nausea	1 (8.3%)	4 (9.3%)	0 (0%)	2 (18.2%)	0.608
Vomiting	1 (8.3%)	3 (7%)	0 (0%)	1 (9.09%)	0.867
Bradycardia	3 (25%)	9 (20.9%)	3 (3.75%)	4 (36.4%)	0.625
Hypotension	7 (58.3%)	12 (27.9%)	2 (25%)	5 (45.5%)	0.196
Respiratory depression	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1
Shivering	1 (8.3%)	10 (23.25%)	2 (25%)	3 (27.3%)	0.664
Pruritus	0 (0%)	2 (4.65%)	0 (0%)	0 (0%)	0.686

Table 2 demonstrates that there was statistically insignificant difference among age groups in the dexmedetomidine group regarding intraoperative adverse events (abdominal discomfort, visceral pain, nausea, vomiting, bradycardia, hypotension, respiratory depression, shivering, and pruritus).

Table (3): Distribution of Post-operative data between age groups in Dexmedetomidine group.

Mean ±SD	**<20 years N = 12**	**20-30 years N =43**	**30-40 years N =8**	**>40 years N =11**	**P-value**
Duration-postoperative analgesia (min)	342.50±81.37	408.84±116.38	435 ±127.28	381.82±81.71	0.201
Time to sensation (min)	287 ±27.08	300.35 ±36.72	307.13 ±31.17	300.64±41.34	0.603

Table 3 demonstrates that there was statistically insignificant difference among age groups in the dexmedetomidine group regarding duration of postoperative analgesia and time to sensation.

Table (4): Distribution of VAS at interval times between age groups in Dexmedetomidine group.

VAS Mean ±SD	**<20 years N = 12**	**20-30 years N =43**	**30-40 years N =8**	**>40 years N =11**	**P-value**
After 1 hour	0.50 ±0.80	0.05 ±0.31	0.25 ±0.71	0.00 ±0.00	**0.017**
After 2 hours	3.25 ±1.49	2.49 ±1.56	1.50 ±1.85	2.36 ±1.21	0.107
After 4 hours	1.00 ±1.21	0.53 ±0.86	0.25 ±0.46	0.45 ±0.69	0.242
After 6 hours	4.33 ±1.23	3.58 ±1.10	3.25 ±1.49	3.64 ±0.92	0.155
After 8 hours	5.67 ±1.44	4.86 ±1.13	4.63 ±1.19	5.27 ±1.27	0.147

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Table 4 shows that there was statistically insignificant difference among age groups in the dexmedetomidine group regarding VAS after 2, 4, 6, and 8 hours, while there was statistically significant difference among age groups in the dexmedetomidine group regarding VAS after 1 hour.

Table (5): Distribution of Bromage at interval times between age groups in Dexmedetomidine group.

Bromage	**<20 years**	**20-30 years**	**30-40 years**	**>40 years**	**P-value**

Mean ±SD	**N = 12**	**N =43**	**N =8**	**N =11**	
After 5 mins	0.83 ±1.19	0.30 ±0.64	0.13 ±0.35	0.36 ±0.51	0.108
After 1 hour	0.50 ±0.52	0.23 ±0.48	0.13 ±0.35	0.36 ±0.67	0.309
After 2 hours	1.17 ±1.03	0.58 ±0.93	0.25 ±0.71	0.64 ±1.21	0.185
After 4 hours	2.75 ±1.60	2.30 ±1.15	1.88 ±0.64	2.27 ±1.19	0.449
After 6 hours	3.92 ±1.44	3.56 ±1.05	3.00 ±0.76	3.55 ±1.04	0.348

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Table 5 demonstrates that, there was statistically insignificant different among age groups in Dexmedetomidine group regarding Bromage after 5 min, after 1, 2, 4, and 6 hours.

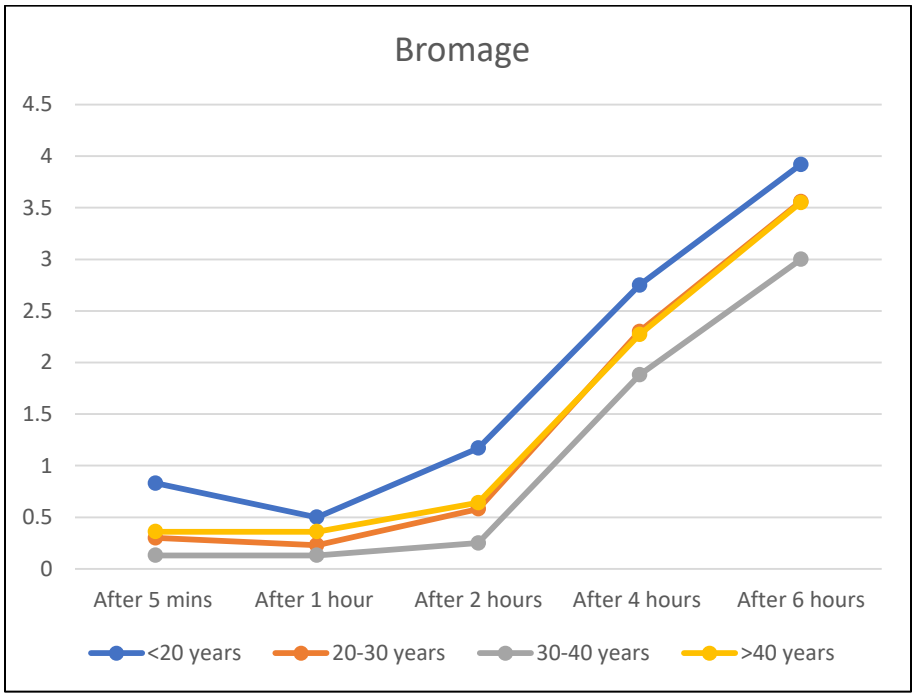

Figure (3): Bromage distribution between age groups in Dexmedetomidine group.

DISCUSSION

Our findings demonstrated that there was statistically insignificant difference among age groups in the Dexmedetomidine group regarding sex, smoking, and operation time, while there was a highly statistically significant difference among age groups in the Dexmedetomidine group regarding ASA.

Older patients often have higher ASA scores due to increased comorbidities and reduced physiological reserve. Our findings align with **Li et al. (7), who** reported that older age is independently related to higher ASA physical status assignments, with an adjusted odds ratio of 1.39 per ten years of age (ninety-five percent CI 1.37 to 1.41).

On the other hand, **Zaib et al. (8),** focusing on patients aged 60 years and above, reported that the ASA score did not demonstrate a significant correlation in this older population.

Our findings demonstrated that there was statistically insignificant difference among age groups in the dexmedetomidine group regarding intraoperative adverse events (abdominal discomfort,

visceral pain, nausea, vomiting, bradycardia, hypotension, respiratory depression, shivering, and pruritus).

In line with Weerink **et al. (9),** who conducted a review to examine various current therapeutic applications of dexmedetomidine, indicating that post-operative pediatric ICU cases over one month exhibited an identical safety profile to that of the adult population.

Gao et al. (10) found that dexmedetomidine use in patient-controlled epidural analgesia reduced the prevalence of itching, nausea, and vomiting compared to opioids, without elevating other adverse events.

A systematic review by **Sin et al. (11)** reported that dexmedetomidine was related to decreased incidence of emergence agitation, pain, cough, post-surgery nausea and vomiting, and shivering in the post-anesthesia care unit. It did increase the prevalence of hypotension, but not residual sedation or bradycardia.

On the other hand, dexmedetomidine's effects appear to vary with age, particularly in younger patients. **Tervonen et al. (12)** reported that neonates and infants (0-3 months) experienced bradycardia more frequently than older infants (3-6 months) when given dexmedetomidine (86% vs 50%, p=0.001). Severe bradycardia was also more common in the youngest patients (17% in neonate's vs 0% in three- to six-month-olds, p-value equal to 0.005).

Our findings demonstrated that there was statistically insignificant difference among age groups in the dexmedetomidine group regarding time to postoperative analgesia and time to sensation.

In line with **Potts et al. (13),** aimed to enhance an understanding of dexmedetomidine pharmacokinetics in pediatric populations, it has been observed that children's drug responses maintain a common receptor, cellular, and physiological foundation with adults, irrespective of age or developmental stage.

Our results showed that there was statistically insignificant difference among age groups in the dexmedetomidine group according to VAS after 2, 4, 6, and 8 hours, while there was statistically significant difference among age groups in the dexmedetomidine group regarding VAS after 1 hour.

Sane et al. (14) reported lower postoperative pain in the dexmedetomidine group for 24 hours in patients aged twenty to sixty years undergoing upper extremity orthopedic operations.

Gao et al. (10) also noted lower VAS scores at multiple time points postoperatively in patients receiving dexmedetomidine compared to opioids.

Interestingly, **Wu et al. (15)** focused on older patients (over 65 years) and found that intranasal dexmedetomidine improved postoperative sleep quality, which may indirectly affect pain perception.

Our findings demonstrated that there was statistically insignificant difference among age groups in the dexmedetomidine group regarding Bromage after 5 min and after 1, 2, 4, and 6 hours.

Sane et al. (14) and Singh et al. (16) examined the impacts of dexmedetomidine as an adjuvant in brachial plexus blocks for adult patients. These studies generally found that adding dexmedetomidine prolonged the motor block period longer than local anesthetic alone.

Interestingly, **Agrawal et al. (17)** used the Bromage score to assess motor block in adult patients (18-60 years) receiving intravenous dexmedetomidine with spinal anesthesia. It reported a longer time to regression of motor block to Bromage 0/1 in the dexmedetomidine group compared to control (274 ± 21.25 min vs 130.12 ± 20.70 min).

CONCLUSION

In conclusion, we found that, despite the absence of age-related differences in most of the outcomes, the significant difference in the ASA classification suggests that comorbidities associated with aging may play an essential role in the general perioperative management of patients receiving dexmedetomidine. The lack of significant variation in other parameters such as intraoperative adverse events, postoperative pain, and sensory recovery highlights the potential of dexmedetomidine to provide consistent therapeutic benefits across different age groups.
Further studies with larger and more diverse patient populations may be necessary to confirm these findings and explore potential mechanisms underlying the observed differences.

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