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Opioid Free Anesthesia versus Opioid Based Anesthesia for Hemodynamic Stability in Geriatric Patients Undergoing Arthroscopic Shoulder Surgery, A Randomized Comparative Study

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ABSTRACT

Background: Physiological and pharmacological variances from younger patients make geriatric patients anesthetically challenging. Opioids though effectively controlling pain may cause serious complications in elderly. Non-opioid analgesics are being considered for adequate analgesia with fewer complications.

Methods: Reaching OR, MAP and HR were recorded (T0), thirty patients were assigned into: OFA group received dexmedetomidine 1 µg/kg over 10 min loading dose, then infusing dexmedetomidine (0.3 µg/kg/h), lidocaine (2 mg/kg/h) and magnesium sulfate (1.5 g/h) during surgery and OA group received fentanyl 2 µg/kg loading dose then infusion (1 µg/kg/h) during surgery. MAP and HR were documented after starting infusions (T1), after intubation (T2), visualizing surgical field with arthroscope (T3) then every 10 min till end. Surgeon graded surgical field (T3) then every 10 min till end. Postoperatively OAA/S, MAP and HR were recorded. NRS was assessed in PACU, at 1 h, 2 h, 8 h, 16 h and 24 h. Patients scoring ≥ 4 received paracetamol 1 gm IV infusion (4 g/24 h maximum dose) documenting first 24 hours total dose and postoperative complications. AMT was assessed postoperatively for three days. Patients scoring<8 were presumed having postoperative cognitive dysfunction (POCD) and were psychiatrically assessed.

Results: MAP and endoscopic surgical field grading (T3) were significantly lower in OFA group than OA group (*P* values 0.008 and 0.001). MAP was significantly lower in OFA group intraoperative (T3 till T9) and two postoperative hours. HR was significantly lower in OFA group at T3 till surgery end and two postoperative hours (except T13). NRS scores were significantly higher in OA group at P0 and P1 than OFA group (P-value 0.001 and 0.007). Postoperative paracetamol dose was significantly higher in OA group than OFA group (P-value 0.005).

Conclusion: OFA offered better hemodynamic control, endoscopic surgical field grading, lower NRS readings and paracetamol dose, presenting better anesthetic option for elderly undergoing arthroscopic shoulder surgery with no POCD or other postoperative complications.

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Non-opioid analgesia; elderly; dexmedetomidine

1. Introduction

GA for geriatric patients is challenging due to physiological and pharmacological variations with age. These variations though compensated during daily life exacerbate during stress periods (major surgeries and anesthesia). Cardiovascular changes as vascular atherosclerosis cause increased blood pressure (especially systolic) affecting left ventricle capability (altering cardiac output) and attenuating reflex of baroreceptors [1]. This renders elderly patients more liable to fluid overload and underload with lack of hemodynamic compensatory mechanisms especially to hypovolemia and hypotension caused by blood loss or drugs [2]. Pulmonary changes also include reduction of forced expiratory volume causing increased physiological shunting and developing more basal atelectasis and post-operative pneumonia predisposing to prolonged hospital stay [3].

Shoulder arthroscopy is minimally invasive, for managing many shoulder joint conditions yet its subsequent pain restricts regaining function and convalescence [4]. Intra-operative bleeding and limited field vision during arthroscopy are common complications causing operative time prolongation. Additionally, patient's sitting position is used among different strategies to overcome these difficulties and shorten surgical duration [5]. These factors affect geriatric patients causing adverse effects affecting hemodynamics, pain perception, and cognitive functions with prolongation of post-operative hospital stay [6].

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Opioid analgesia is standard practice in perioperative setting however, drug metabolism and distribution are transformed with aging [7]. So studies are emerging trying to introduce non-opioid substitutions using multimodal techniques with different drugs combination to elude many opioid associated complications as prolonged anesthesia, PONV, POCD and complications related to prolonged bed and hospital stay affecting geriatric patients prolonging the recovery period.

This study compared OFA combining dexmedetomidine, magnesium sulphate and lidocaine to traditional fentanyl for intra-operative and post-operative analgesia studying alterations in hemodynamics, surgeons' satisfaction, post-operative analgesia and complications especially POCD in geriatric patients undergoing shoulder arthroscope surgery, which to our knowledge wasn't assessed before.

2. Patients and methods

This randomized double blinded controlled study was accomplished in orthopedic surgery OR after granting Institutional Ethical Committee approval (MS-201-2022), Clinical Trial registration (ClinicalTrials.gov NCT05577117) and written informed consent from 30 patients of ASA status I or II >65 years old undertaking arthroscopic shoulder surgery under GA.

Inclusion criteria included patients of ASA status I or II >65 years old undertaking elective arthroscopic shoulder surgery under GA. Patients with uncontrolled sicknesses affecting organs (e.g., hypertension, diabetes, or chronic respiratory disease), extensive organ dysfunction (e.g., cardiac, respiratory, renal, or liver disorders), morbid obesity (BMI >35), allergy history to any of study drugs, and chronic opioid or beta blockers usage were omitted from the study.

Upon OR arrival, Standard monitoring (pulse oximetry, non-invasive blood pressure, and electrocardiography) was applied. Baseline MAP and HR measurements were recorded (T0) and patients received pre-induction paracetamol 1 g, dexamethasone 0.1 mg/kg, lidocaine 1 mg/kg IV bolus doses.

Patients were then randomly assigned into two groups via closed envelopes to OFA group ($n = 15$) who received dexmedetomidine loading dose of 1 µg/kg over 10 minutes. Then continuous infusion of dexmedetomidine at rate 0.3 µg/kg/h (3mic/ml concentration), lidocaine at rate 2 mg/kg/h and magnesium sulfate at rate 1.5 g/h during surgery in three infusing syringes and OA group ($n = 15$) received fentanyl 2 µg/kg as loading dose with three additional 10 ml saline syringes for blinding followed by continuous infusion at rate 1 µg/kg/h (10mic/ml concentration) during surgery with two additional 20 ml saline syringes infused with a rate equivalent to lidocaine and magnesium sulfate for blinding.

Regimens were prepared by an author (not blinded to assigned groups) while another anesthesiologist recorded data (blinded to prepared regimen and patients' assigned group) along with the patient himself.

GA induction was performed by propofol 1–2 mg/kg slowly titrated to loss of verbal communication and atracurium 0.5 mg/kg IV to facilitate intubation. GA was maintained by controlled ventilation of 1% isoflurane in 100% oxygen maintaining ETCO2 between 35 and 40 mmHg. Hemodynamic measurements (MAP and HR) were recorded after start of study drugs infusion (T1), after intubation (T2), 10 minutes later with surgical field visualization with arthroscope (T3) then every 10 min till surgery end. Surgery was started after local anesthetic infiltration at incision site. Surgeon was asked for grading surgical field visualized with arthroscope (T3) then every 10 min till surgery end utilizing a scale adjusted by *Fromme et al*. [8] and *Boezaart et al*. [9]. Grade0 expressed no bleeding (cadaveric condition), grade1 expressed slight bleeding with no suctioning required, grade2 expressed slight bleeding with occasional suctioning required, grade3 expressed slight bleeding with frequent suctioning required or bleeding threatening surgical field few seconds after suction is removed, grade4 expressed moderate bleeding with frequent suctioning required and bleeding threatening surgical field directly after suction is removed while grade5 expressed severe bleeding with constant suctioning required, bleeding appearing faster than can be removed by suction and surgical field severely threatened (surgery usually not possible). If any regimen couldn't maintain scale < 3 phentolamine 1–5 mg was administered, technique was considered failed and dose of phentolamine used to achieve target surgical field was calculated but recorded as failed technique. If MBP dropped <60 mmHg, study drug infusion rate was decreased by 20%, IV fluids rate was increased and 5 mg ephedrine IV bolus was injected. If prolonged hypotension (>2 minutes) occurred, study drug infusion was stopped, and patient was omitted from the study.

Ending surgery, infusion drugs were stopped, extubation time (from beginning of wound dressing till endotracheal tube removal) was recorded and extubation was done after regaining full neuro-muscular power then patients were moved to PACU.

Modified Observer's Assessment of Alertness and Sedation (OAA/S) [10] was evaluated on arrival. Score of 5 indicated readily response to normal tone spoken name, 4 indicated lethargic response to normal tone spoken name, 3 indicated response only to name called loudly and/or repeatedly, 2 indicated response only to mild prodding or shaking, 1 indicated response only to painful trapezius squeeze and 0 indicated No response even with painful trapezius squeeze.

Additionally, MAP and HR were recorded on arrival, at 30 minutes, 1hour, and 2 hours. Numerical rating scale (NRS) was assessed on arrival, at 1hour, 2 hours, 8 hours, 16 hours and 24 hours and documented for postoperative pain assessment [11]. NRS is an 11-point scale, 0 stated no pain at all and 10 stated the worst pain imagined. Patients with score ≥ 4, received paracetamol 1 gm IV infusion 4 g/24 h maximum daily dose) and paracetamol total dose was calculated during the first 24 hours. Occurrence of postoperative nausea, vomiting, bradycardia, hypoxia and shivering was recorded in PACU.

Abbreviated Mental Test (AMT) score [12] was documented after recovery, 8 hours following surgery (Day-0) and on the following three days (Day-1, Day-2 and Day-3) at the same time of evaluation on day 0. The questionnaire includes patient's name, time (to the nearest hour), current year, hospital's name, address to recall, identifying two surrounding personnel (e.g., physician, nurse), patient's birthday date, year of any famous event, name of the present president and counting from 20 to 1. Each answer got 1 point and total score was calculated. Patients having scores < 8 were assumed to have post-operative cognitive dysfunction (POCD) for additional psychiatric assessment.

3. Study outcomes

The primary outcome is comparing intraoperative MAP (mmHg) between both groups at time of surgical field visualization with arthroscope (T3) and comparing to endoscopic surgical field grading system while secondary outcomes included demographic data (age, gender, ASA score), endoscopic surgical field grading system, trends of MAP(mmHg) and HR (b/min), duration of surgery (minutes), failed technique, phentolamine dose achieving target surgical field (mic/kg), extubation time, OAA/S score, AMT score, Postoperative NRS, postoperative paracetamol total dose and postoperative complications (nausea, vomiting, bradycardia, hypoxia and shivering).

4. Statistical analysis

A sample size of 24 increased to 30 patients for dropouts compensation with 0.05 significance level and 95% power of test based on a pilot study with five patients in each group showing MAP mean of 63 ± 8 and SD 75 ± 12 mmHg for OFA and OA groups respectively at time of surgical field visualization with arthroscope (T3).

SPSS statistical package (version17) was used for data evaluation. Student's t-test was used for parametric demographic data evaluation; qualitative data were compared using Chi-square test or Fisher's exact test as suitable. Arithmetical data were defined as mean and SD or median and range as suitable. While qualitative data were defined as frequency and percentage, P˂0.05 was considered statistically significant.

5. Results

Thirty-six patients were screened for eligibility, 6 patients were omitted for not meeting inclusion criteria, and thirty were allocated into two equal groups and were available for final analysis.

5.1. Demographic data

5.1.1. Age

Mean age in group OFA was 70.1 years (range 65-80 years), with SD ±4.6 years, while mean age in group OA was 70.8 years (range 65-83 years), with SD ±5.4 years with no significant difference (P-value 0.690).

5.1.2. Gender

Nine males (60%) and six females (40%) were present in group OFA, and 11 males (73%) and four females (26.7%) in group OA with no significant difference (P-value 0.439).

5.1.3. ASA score

Nine patients were ASA I (60%) and six patients were ASA II (40%) in group OFA, while 11 patients were ASA I (73.3%) and four patients were ASA II (26.7%) in group OA with no significant difference (P-value 0.439).

5.1.4. Operative time

Mean operative time in OFA group was 98.67 minutes (range 60–120 minutes), SD ±26.15 minutes, and 104 minutes (range 60–120 minutes), SD ±20.28 minutes in OA group with no significant difference (P-value 0.538).

5.2. Mean arterial pressure

OFA group showed significantly lower readings than OA group starting at time of surgical field visualization with arthroscope (T3) till T9 intraoperative and at P2 and P3 postoperatively (Table 1).

5.3. Heart rate

OFA group showed statistically lower readings than OA group starting at T3 till the end and within the two postoperative hours in PACU with the exception of T13 (Table 2).

5.4. Endoscopic surgical field grading system

OFA group showed significantly lower (better) grading than OA group. One patient graded 0, seven patients graded 1, five patients graded 2 and two patients graded 3 in OFA group, while in

Table 1. Mean Arterial Pressure.

	OFA group				OA group				
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	P-value
T0	98.8	16.5	77.0	128.0	89.5	11.2	70.0	108.0	0.081
T1	84.1	17.7	62.0	129.0	84.2	16.4	45.0	108.0	0.992
T2	81.7	16.0	55.0	115.0	92.9	14.2	74.0	121.0	0.051
T3*	81.1	11.3	63.0	106.0	92.9	11.4	70.0	112.0	0.008
T4	77.6	10.8	62.0	102.0	79.5	10.1	73.0	98.0	<0.001
T5	76.2	14.0	60.0	106.0	88.6	12.7	67.0	111.0	0.017
T6	75.3	11.9	60.0	93.0	86.1	12.2	63.0	113.0	0.020
T7	74.2	9.8	63.0	94.0	88.3	14.5	67.0	116.0	0.004
T8	73.3	11.1	63.0	105.0	89.7	13.4	71.0	117.0	0.001
T9	74.0	6.9	65.0	87.0	90.0	9.6	77.0	117.0	<0.001
T10	75.1	10.9	60.0	100.0	84.3	13.3	58.0	106.0	0.062
T11	78.5	10.5	66.0	98.0	81.2	10.3	65.0	96.0	0.550
T12	78.2	12.7	63.0	104.0	86.0	14.8	59.0	115.0	0.214
T13	78.2	9.0	66.0	90.0	85.1	17.4	48.0	109.0	0.302
T14	78.0	8.9	64.0	89.0	85.1	14.1	67.0	108.0	0.227
T15	74.4	9.7	57.0	88.0	85.9	12.7	62.0	107.0	0.062
P0 (PACU)	78.9	8.7	66.0	95.0	85.2	11.3	67.0	111.0	0.100
P1 (30 min)	76.9	11.2	65.0	98.0	83.7	12.9	65.0	113.0	0.135
P2 (1 hr)	76.9	10.5	67.0	95.0	90.4	14.1	74.0	122.0	0.006
P3 (2 hr)	84.5	10.5	70.0	100.0	94.9	13.5	80.0	121.0	0.026

Data are expressed as mean ±standard deviation.
Group OFA: opioid free anesthesia, Group OA: opioid anesthesia. P-value <0.05.
*: The time of surgical field visualization with arthroscope.

Table 2. Heart Rate.

	OFA group				OA group				
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	P-value
T0	97.0	18.6	68.0	124.0	95.3	12.2	66.0	116.0	0.774
T1	86.1	13.1	57.0	107.0	96.8	21.2	57.0	130.0	0.109
T2	82.8	10.2	70.0	107.0	87.5	9.3	67.0	100.0	0.200
T3*	79.3	11.3	58.0	98.0	92.9	14.7	68.0	112.0	0.008
T4	75.0	10.3	63.0	99.0	88.6	15.3	65.0	117.0	0.003
T5	76.5	12.8	60.0	105.0	88.1	15.8	64.0	118.0	0.037
T6	73.3	10.7	59.0	94.0	92.8	17.2	59.0	126.0	0.001
T7	73.0	9.8	55.0	89.0	90.0	16.7	64.0	117.0	0.002
T8	70.0	13.0	46.0	93.0	85.7	14.4	57.0	106.0	0.004
T9	70.3	11.9	47.0	87.0	87.0	10.4	64.0	99.0	<0.001
T10	72.0	11.1	51.0	90.0	92.1	11.6	70.0	119.0	<0.001
T11	73.4	10.7	60.0	98.0	85.2	10.1	65.0	105.0	0.013
T12	75.6	11.9	60.0	96.0	89.5	12.0	65.0	110.0	0.014
T13	74.6	9.4	60.0	88.0	85.0	13.4	64.0	101.0	0.068
T14	73.3	10.1	60.0	90.0	85.4	12.5	69.0	100.0	0.044
T15	71.1	9.9	55.0	84.0	82.5	9.0	71.0	95.0	0.031
P0(PACU)	75.2	11.3	54.0	98.0	88.7	9.9	72.0	100.0	0.002
P1 (30 min)	76.1	11.9	60.0	94.0	87.7	8.5	67.0	101.0	0.004
P2 (1 hr)	79.8	13.9	62.0	108.0	94.9	10.5	76.0	110.0	0.002
P3 (2 hr)	81.3	14.6	65.0	112.0	93.9	11.8	75.0	120.0	0.015

Data are expressed as mean ±standard deviation.
Group OFA: opioid free anesthesia, Group OA: opioid anesthesia. P-value <0.05.
*: The time of surgical field visualization with arthroscope.

OA group three patients graded 2, six patients graded 3 and six patients graded 4, respectively. These significant differences were documented starting at T3 till surgery end (Table 3).

5.5. Comparing MAP and endoscopic surgical field grading system at time of surgical field visualization with arthroscope (T3)

Both MAP readings and endoscopic surgical field grading system scores showed significantly lower values in OFA group than OA group (P-values 0.008 and 0.001) (Figure 1 and Figure 2).

5.5.1. Failed technique and phentolamine dose

Phentolamine wasn't used in any patient among both groups.

5.5.2. Extubation time

Results showed no statistically significant difference among both groups. (P-value 0.070)

Table 3. Endoscopic surgical field grading system.

		OFA group		OA group		
		Count	%	Count	%	P-value
T3 *	0	1	6.7%	0	0.0%	0.001
	1	7	46.7%	0	0.0%	
	2	5	33.3%	3	20.0%	
	3	2	13.3%	6	40.0%	
	4	0	0.0%	6	40.0%	
T4	0	4	26.7%	0	0.0%	<0.001
	1	7	46.7%	0	0.0%	
	2	3	20.0%	2	13.3%	
	3	1	6.7%	7	46.7%	
	4	0	0.0%	6	40.0%	
T5	0	7	46.7%	0	0.0%	<0.001
	1	5	33.3%	0	0.0%	
	2	2	13.3%	2	13.3%	
	3	1	6.7%	7	46.7%	
	4	0	0.0%	5	33.3%	
	5	0	0.0%	1	6.7%	
T6	0	9	60.0%	0	0.0%	<0.001
	1	3	20.0%	1	6.7%	
	2	2	13.3%	2	13.3%	
	3	1	6.7%	6	40.0%	
	4	0	0.0%	6	40.0%	
T7	0	12	80.0%	0	0.0%	<0.001
	1	1	6.7%	2	13.3%	
	2	1	6.7%	2	13.3%	
	3	1	6.7%	6	40.0%	
	4	0	0.0%	5	33.3%	
T8	0	10	66.7%	0	0.0%	<0.001
	1	4	26.7%	3	20.0%	
	2	1	6.7%	2	13.3%	
	3	0	0.0%	4	26.7%	
	4	0	0.0%	6	40.0%	
T9	0	10	66.7%	0	0.0%	<0.001
	1	4	26.7%	3	20.0%	
	2	1	6.7%	1	6.7%	
	3	0	0.0%	7	46.7%	
	4	0	0.0%	4	26.7%	
T10	0	9	69.2%	0	0.0%	<0.001
	1	3	23.1%	2	14.3%	
	2	1	7.7%	3	21.4%	
	3	0	0.0%	5	35.7%	
	4	0	0.0%	4	28.6%	
T11	0	5	50.0%	0	0.0%	<0.001
	1	3	30.0%	1	7.7%	
	2	2	20.0%	2	15.4%	
	3	0	0.0%	7	53.8%	
	4	0	0.0%	3	23.1%	
T12	0	5	55.6%	0	0.0%	0.001
	1	3	33.3%	2	15.4%	
	2	1	11.1%	1	7.7%	
	3	0	0.0%	6	46.2%	
	4	0	0.0%	4	30.8%	
T13	0	5	55.6%	1	10.0%	0.001
	1	4	44.4%	0	0.0%	
	2	0	0.0%	1	10.0%	
	3	0	0.0%	4	40.0%	
	4	0	0.0%	4	40.0%	
T14	0	6	66.7%	0	0.0%	0.001
	1	3	33.3%	1	12.5%	
	2	0	0.0%	1	12.5%	
	3	0	0.0%	2	25.0%	
	4	0	0.0%	4	50.0%	
T15	0	3	37.5%	1	12.5%	0.027
	1	5	62.5%	1	12.5%	
	3	0	0.0%	2	25.0%	
	4	0	0.0%	4	50.0%	

Data are expressed as count and range.
Group OFA: opioid free anesthesia, Group OA: opioid anesthesia. P-value <0.05.
*: The time of surgical field visualization with arthroscope.

5.5.3. OAA/S score

Scores showed no statically significant difference between both groups. (P-value 0.102)

5.5.4. AMT score

All patients among both groups showed scores > 8 with no significant difference.

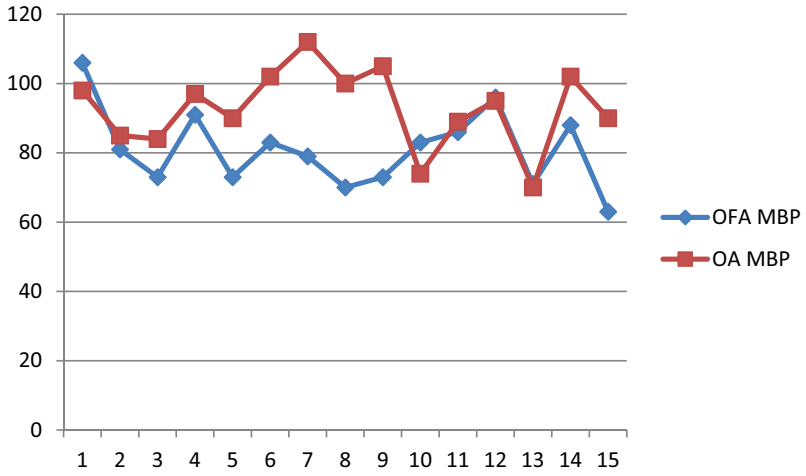

Figure 1. Mean Arterial Pressure at T3. Group OFA:opioid free anesthesia, Group OA: opioid anesthesia. P-value <0.05.

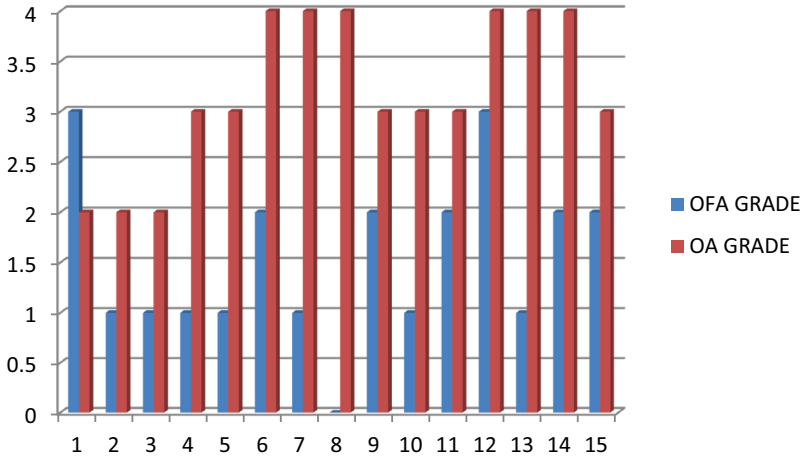

Figure 2. Endoscopic surgical field grading system at T3. Group OFA:opioid free anesthesia, Group OA: opioid anesthesia. P-value <0.05.

5.6. Numerical rating scale

NRS reading showed a statistically significant difference between both groups on arrival to PACU (P0) and 1 hour post-operative (P1) with higher score for OA group (6 scored 4 points and 4 scored 5 points at P0 and 3 scored 4 points at P1) than OFA group (2 scored 4 points at P0 and 1 scored 4 points at P1). Table 4

5.7. Post-operative analgesia

Post-operative paracetamol (to avoid affecting patients cognitive functions that may bias AMT results) dose was significantly higher in OA group than OFA group. Patients received analgesia according to NRS score. In OA group six patients received 1 gm (once) and five patients received 2 gm total dose (two doses 1 gm each) of paracetamol compared to OFA group where only three patients received 1 gm (once) total paracetamol dose (P-value 0.005) (Table 4).

5.7.1. Postoperative side effects

No significant difference was found between both groups regarding postoperative nausea, vomiting, bradycardia, hypoxia and shivering.

6. Discussion

The study based its anesthetic technique on the practice used by *Mulier* [12] who used a combination of drugs performing sympathetic stabilization (dexmedetiomidine an alpha-2-agonist) in addition to loco-regional analgesics (lidocaine) and magnesium. When this multimodal methodology is used, opioid sparing could be established, to avoid its adverse effects (as nausea, vomiting, bradycardia, hypoxia, shivering and cognitive dysfunction) especially in the geriatric population. Moreover, using multiple agents with synergistic effect causes their dose reduction, thus reducing their adverse effects.

Beloeil H. et al. [13] study compared intraoperative dexmedetomidine (intraoperative infusion rate 0.4–1.4 mic/kg/h) to remifentanil with morphine as target

Table 4. Numerical Rating Scale (NRS) and postoperative paracetamol total dose.

		OFA group		OA group		
		Count	%	Count	%	P value
NRS P0	1	3	20.0%	0	0.0%	0.001
	2	7	46.7%	0	0.0%	
	3	3	20.0%	5	33.3%	
	4	2	13.3%	6	40.0%	
	5	0	0.0%	4	26.7%	
NRS P1	1	3	20.0%	0	0.0%	0.007
	2	8	53.3%	2	13.3%	
	3	3	20.0%	10	66.7%	
	4	1	6.7%	3	20.0%	
NRS P2	1	2	13.3%	0	0.0%	0.158
	2	7	46.7%	4	26.7%	
	3	6	40.0%	8	53.3%	
	4	0	0.0%	3	20.0%	
NRS P3	1	1	6.7%	0	0.0%	0.093
	2	10	66.7%	8	53.3%	
	3	4	26.7%	7	46.7%	
NRS P4	1	1	6.7%	0	0.0%	1
	2	8	53.3%	8	53.3%	
	3	6	40.0%	7	46.7%	
NRS P5	1	2	13.3%	0	0.0%	0.439
	2	10	66.7%	10	66.7%	
	3	3	20.0%	5	33.3%	
Paracetamol Analgesia	**No**	12	80.0%	4	26.7%	0.005
	Once	3	20.0%	6	40.0%	
	Twice	0	0.0%	5	33.3%	

Data are expressed as count and percentage.
Group OFA:opioid free anesthesia, Group OA: opioid anesthesia. P-value <0.05.

controlled infusion (adjusted to patient's HR) in 316 patients undergoing moderate to major non-cardiac surgeries. Patients of both groups received IV lidocaine and ketamine (preoperative bolus and intraoperative infusion). Results showed increased intraoperative bradycardia risk (to a point of stopping infusion) and postoperative hypoxia in dexmedetomidine group compared to remifentanil group. Postoperative ilius and POCD presented no significant difference between groups. Taking their results into consideration, we used intraoperative dexmedetomidine infusion rate of 0.3 µg/kg/h (3mic/ml concentration) to avoid severe bradycardia especially with geriatric target population.

Study conducted by *Eldin Abdel Hamid, M.H.* [14] compared dexmedetomidine to fentanyl for intraoperative analgesia in 60 patients aged 30–50 years undergoing shoulder surgery. DEX group received dexmedetomidine 1 µg/kg over 10 min loading dose then continuous intraoperative infusion at rate 0.5 µg/kg/. FEN group received fentanyl 1 µg/kg loading dose then continuous intraoperative infusion at rate 0.5 µg/kg/h. Study showed similar results to our study as hemodynamic readings (MAP and HR) showed significantly lower results in DEX group than FEN group after infusion till 2 hours postoperative. Also surgeons' satisfaction was significantly more among DEX group than FEN group. But unlike our study they found a significantly lower modified OAA/S score in DEX group than FEN group. The study showed a significantly lower visual analog scale in DEX group for 2 postoperative hours, while our NRS showed statistically significant lower scores in OFA group than OA group on PACU arrival and 1hour later only with no significant difference for the following 3postoperative days in both groups. Moreover we were apprehensive to monitor POCD using AMT score displaying scores > 8 denoting no affection in both study groups.

Olausson A. et al. [15] meta-analysis contained 1934 patients undergoing different surgical procedures comparing adverse effects using OA versus OFA with alternatives as dexmedetomidine, ketamine, lidocaine and esmolol, they presented OFA as a substitute for OA being safe and effective with less postoperative adversarial effects and opioid consumption without any risk increase or intraoperative complications especially in gynecological and gastrointestinal laparoscopic procedures. Their study showed significantly less incidence of PONV with OFA.

On the contrary, a study by *Menshawi, M.A. et al*. [16] in which group(D) received dexmedetomidine lµg/kg IV infusion over 10 min before induction then continuous intraoperative IVinfusion 0.3–0.6 µg/kg/h while group(R) received remifentanil 1 µg/kg IV bolus before induction and 0.25–0.50 µg/kg/min intraoperative IVinfusion. In both groups, drugs were titrated to attain MAP of 60-70 mmHg. Hemodynamics, surgical field conditions, recovery profile, and incidence of perioperative adverse events were assessed showing no significant difference among groups regarding intraoperative hemodynamics except significantly lower postoperative HR in group(D). Surgical field condition were satisfactory in both groups, mostly due to drugs

titration to maintain similar hemodynamic conditions and not testing drug doses effects. Extubation time, time to reach modified Aldrete score ≥ 9 and time to 1st postoperative analgesic requirement were significantly longer in group(D). Postoperative Ramsay sedation score recordings were significantly higher in group(D) except at 2 hours postoperative and VAS score was significantly lower in group(D). But similar to our study the incidence of perioperative adverse events was comparable in both groups.

Efstathiou G. et al. [17] conducted a study on 15 elderly patients undergoing transurethral urological procedures assessing POCD with mini mental state examination (MMSE) test, concluding that multimodal OFA caused no POCD compared to preoperative examination.

Likewise, study by *Kim, N. et al*. [18] assessed POCD with dexmedetomidine. They compared results of 80 elderly patients undergoing shoulder surgery in sitting position. In group(D) they added dexmedetomidine intraoperative IV infusion at rate 0.6mic/kg/h while in group(C) normal saline infusion was administered with remifentanil IV bolus 0.5-1mic/kg with GA induction. Results showed no incidence of POCD by assessing MMSE-K for 24 hours postoperative. Results showed no additional risk with dexmedetomidine in first 24 hours after surgery as our study suggested. Moreover, we tested for POCD for three whole days starting on arrival at PACU and 3 days afterwards using AMT score.

P Ziemann-Gimmel et al. [19] assessed risk of PONV, using Likert scale to assess severity for patients undergoing bariatric surgery comparing GA with opioids to TIVA with dexmedetomidine. Results showed lower PONV incidence and risk with OFA by 17.3% than classic OA despite receiving triple prophylaxis.

7. Limitations

Wider target population should be investigated [20] comparing multiple infusion rates to determine optimum rate with least complications. Direct blood pressure monitoring may be more accurate for hemodynamic changes.

8. Conclusion

OFA for elderly undergoing arthroscopic shoulder surgery provides better hemodynamic control and surgical field condition, less postoperative pain and need for analgesia with no effect on POCD or other postoperative adverse effects than traditional GA.

List of abbreviations

OR	Operation room
MAP	Mean arterial pressure
HR	Heart rate
OFA	Opioid free anesthesia
OA	Opioid aesthesia
OAA/S	Modified Observer's Assessment of Alertness and Sedation
NRS	Numerical rating scale
PACU	Post anesthesia care unit
AMT	Abbreviated mental test
POCD	Postoperative cognitive dysfunction
GA	General anesthesia
ASA	American society of anesthesiologists
BMI	Body mass index
IV	Intra venous
$ETCO_2$	End tidal carbon dioxide
SD	Standard deviation
PONV	Postoperative nausea and vomiting
TIVA	Total intra venous anesthesia

Disclosure statement

No potential conflict of interest was reported by the author(s).

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