

## Cataract Surgery under Conventional Sedation with Dexmedetomidine: Efficacy and Safety in Patients with Psychiatric or Neurological Conditions

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Received date: July 13, 2018; Accepted date: July 20, 2018; Published date: July 27, 2018

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### Abstract

**Objective:** Cataract is one of the leading causes of blindness in the world. The number of the cataract surgery has been increasing year-by-year according to the aging society. Cataract surgery can be operated on using only topical anesthesia, but general anesthesia (GA) is sometimes applied to suppress body motion due to the patient's psychological situation. Dexmedetomidine (DEX) is a sedative drug that does not inhibit the respiratory center, considering alternative for GA. We investigated the systemic conditions during cataract surgery using sedation with DEX among cataract patients unfit for topical anesthesia due to older age, dementia, claustrophobia, belonephobia, and/or mental disorders. We also measured 'necessary time' during cataract surgeries that will make sense output efficiencies of the cataract surgery.

**Methods:** Among medical records of 1,935 consecutive cataract surgeries, general anesthesia (GA) and DEX were used for 59 and 22 patients, respectively. Retrospective, historical, interventional, consecutive case series. Necessary time was defined as the time subtracted from entry-exit time to surgery time.

**Results:** The highest blood pressure (BP) (systolic/diastolic) and heart rate (HR) were significantly higher ( $P < 0.001$ ) in the GA group than in the DEX group. The lowest BP (systolic/diastolic) was significantly lower ( $P < 0.001$ ) in the GA group than in the DEX group. Peripheral oxygen saturation ( $SpO_2$ ) showed no significant differences between groups. Necessary time was significantly shortened in the DEX group ( $23.5 \pm 7.9$  min) compared to the GA group ( $49.1 \pm 10.7$  min) ( $P < 0.001$ ).

**Conclusion:** Sedation with DEX decreased hemodynamic stress and shortened necessary time during cataract surgery. It may have a favorable impact on patients' systemic conditions and profound economical effect.

**Keywords:** Cataract surgery; Dexmedetomidine; General anesthesia; Time; Elderly patients

### Introduction

Cataract is one of the leading causes of blindness in the world. In Japan, more than 1.5 million cataract surgeries are performed every year and the number of procedures performed is gradually increasing as the population ages. Cataract surgery is finished around 15 min but requires cooperation by the patients because of the delicate technique required. Most cases can be operated on using only topical anesthesia such as eye drops and/or sub-Tenon's lidocaine injection. However, general anesthesia (GA) or other sedative drugs are sometimes applied to suppress body motion due to the patient's psychological situation; in particular, dementia, claustrophobia, belonephobia, and/or some mental disorders. The loss of visual function can also involve cognitive

behavior and falling down due to visual impairment in elderly persons [1-4]. Systemic safety and low-load cataract surgery is needed for not only quality of vision, but also quality of life.

Dexmedetomidine (DEX) is, though a conventional drug, a highly selective,  $\alpha$ -2-adrenoreceptor agonist, with both sedative and analgesic properties, and is relatively devoid of respiratory depressant effects [5-8]. Other sedative drugs such as propofol, benzodiazepines, or opioids cause respiratory depression, hypoxemia, and apnea. These sedative drugs sometime require the anesthesiologist to carefully maintain the patient's airway during and after surgery [9,10]. Previous pharmacological studies showed that DEX is a favorable sedative agent for procedures involving mild pain [11].

In the present study, we performed cataract surgeries using sedation with GA or DEX in patients unlikely to be able to control their body movements or who had psychological conditions. Then, we

investigated select biological parameters and necessary time between the two groups as objective indexes.

## Materials and Methods

The study was approved by the appropriate Institutional Review Board (IRB) from the Institutional Review Board of Health Sciences University of Hokkaido General Hospital (#2017-004) and Sunagawa City Medical Center (2017#16) for Clinical Research. Four experienced ophthalmologists performed 1,935 consecutive cataract surgeries from September 2013 to October 2017. Surgical procedure among this period is almost the same. All patients, though excluding few of the GA patients, were operated on with local anesthetic eye drops or sub-Tenon's lidocaine injection. Among them, 4.2% received the surgery under GA or DEX sedation because of their body motion at the surgeons' discretion. Before September 2016, all such cases received GA (24 males and 35 females). After October 2016, DEX was used (7 males and 15 females) for all such following cases. These patients were diagnosed with dementia, needle phobia/claustrophobia, mental disorders, and others. This is a historical retrospective comparative study. The patients who underwent GA or DEX stayed overnight at the hospital.

Baseline heart rate (HR) and systolic/diastolic blood pressure (BP) were measured upon admission. On arrival to the operating theater, basic monitors were attached. HR, BP, and oxygen saturation (SpO<sub>2</sub>) were recorded throughout the operation. After the start of the GA or DEX infusion, these monitors recorded parameters continuously or every 10 min. All cases where GA was used received inhalation air, sevoflurane, and oxygen, intravenous anesthesia (propofol, fentanyl, remifentanyl, and rocuronium) under tracheal intubation. The DEX group was controlled with spontaneous breathing alone. As a loading dose, 6 µg/kg/h of DEX was infused within 10 min. The maintenance dose (0.2 µg/kg/h-0.7 µg/kg/h) was subsequently administered to the

patients according to the manufacturer's instructions. In both the GA and DEX groups, the amount of anesthetic was determined by the anesthesiologists' and surgeons' consideration depending on the patients' conditions. Lidocaine eye drops and/or sub-Tenon's injection were used in the DEX group and some in the GA group. In DEX-sedated patients, infusion reduction, tapping the patient's shoulder, or oxygen inhalation was administered appropriately in cases where SpO<sub>2</sub> decreased (continuous less than 95%). The decision of the transferring from the operating room is depend on the Glasgow Coma Scale (GCS); Eye (4), Verbal (5), and Motor (6), in both groups.

We also evaluated the time which was subtracted from entry-exit time to surgery time, defined as 'necessary time'. Parametric variables such as age, HR, BP, SpO<sub>2</sub>, and necessary time were analyzed using a two-sided t-test. P<0.05 was considered as statistically significant.

## Results

The majority of cataract patients (95.8%, 1,854/1,935) were operated on with only topical anesthesia. The remaining 59 out of 1,200 (4.9%) received GA, and 22 out of 735 (3.0%) were given DEX due to their psychiatric or neurological conditions. No significant differences in baseline characteristics were observed between the GA and DEX groups (Table 1). The highest (systolic/diastolic) BP was significantly higher in the GA group than in the DEX group (172.3 ± 25.4/94.8 ± 14.8 vs. 151.5 ± 26.0/81.8 ± 10.9; P=0.00094/P=0.00021). The lowest systolic/diastolic BP was significantly lower in the GA group than in the DEX group (85.3 ± 13.8/50.8 ± 9.5 vs. 116.4 ± 23.4/65.4 ± 13.5; P=1.1 × 10<sup>-10</sup>/P=4.0 × 10<sup>-7</sup>). The highest HR was significantly higher in the GA group than in the DEX group (107.6 ± 18.0 vs. 81.5 ± 14.7; P=4.5 × 10<sup>-8</sup>) and the lowest HR was lower, but not significantly, in the GA group compared to the DEX group (52.1 ± 10.3 vs. 56.3 ± 9.3; P=0.051). The lowest SpO<sub>2</sub> was not significantly different between the two groups (94.3 ± 5.9 vs. 94.0 ± 3.2; not significant).

		GA	DEX	
<b>Gender</b>	Male	24/59 40.7%	7/22 31.8%	n.s.
<b>Age</b>		77.6 ± 10.2	77.5 ± 8.2	n.s.
<b>Blood pressure</b>	at rest	120.9 ± 17.0/71.6 ± 12.1 mmHg	124.0 ± 24.2/68.1 ± 12.4 mmHg	n.s.
<b>(systolic/diastolic)</b>	maximum during operation	172.3 ± 25.4/94.8 ± 14.8 mmHg	151.5 ± 26.0/81.8 ± 10.9 mmHg	0.00094/0.00021
	minimum during operation	85.3 ± 13.8/50.8 ± 9.5 mmHg	116.4 ± 23.4/65.4 ± 13.5 mmHg	1.1 × 10 <sup>-10</sup> /4.0 × 10 <sup>-7</sup>
<b>Heart rate</b>	at rest	73.4 ± 18.2/min	70.6 ± 13.4/min	n.s.
	maximum during operation	107.6 ± 18/min	81.5 ± 14.7/min	4.5 × 10 <sup>-8</sup>
	minimum during operation	52.1 ± 10.3/min	56.3 ± 9.3/min	0.051
<b>SpO<sub>2</sub></b>	at rest	98.4 ± 2%	98 ± 1.6%	n.s.
	minimum during operation	94.32 ± 5.9%	94 ± 3.2%	n.s.
<b>Necessary time</b>		49.14 ± 10.7/min	23.5 ± 7.9/min	3.6 × 10 <sup>-16</sup>

**Table 1:** Systemic conditions and consuming times during cataract surgery between the cases with general anesthesia (GA) and sedation with dexmedetomidine (DEX) among cataract patients. Data are displayed as mean SD or n (%). GA: General Anesthesia; DEX: Dexmedetomidine; SpO<sub>2</sub>: Oxygen Saturation; Necessary time: subtracted from total entry-exit time to operation time.

The necessary time was significantly shorter in the DEX group (23.5 ± 7.9 min) than in the GA group (49.1 ± 10.7 min; P=3.6 × 10<sup>-16</sup>).

In the GA and DEX groups, there were 26 (44.1%) and 10 (45.5%) patients with dementia, 12 (20.3%) and 7 (31.8%) with claustrophobia/

belonephobia, 13 (22.0%) and 1 (4.5%) with body stabilization difficulties, 5 (8.5%) and 2 (9.1%) with tremor, and 3 (5.1%) and 2 (9.1%) with mental retardation, respectively.

Low SpO<sub>2</sub> (<90%) was seen in 9 (15.3%) and 2 cases (9.1%) in the GA and DEX group, respectively. Among DEX groups, these cases were only treated by tapping the patient's shoulder, oxygen administration *via* an oral mask infusion reduction, or depending on the surgeons' consideration at the time of the operation. Body motion was seen in 2 cases in the DEX group, but surgeons could continue to operate after a several min observation. A drop in BP (<80/50 mmHg) was seen 19 (32.2%) and 1 case (4.5%) in the GA and DEX group, respectively. HR (<40 beats per min) was seen in 8 (13.8%) and 2 (9.1%) in GA and DEX group, respectively. There were no severe systemic complications during or after the operation in both groups.

## Discussion

Here, we present a comparative report of GA and DEX used during cataract surgery for elderly patients with dementia, claustrophobia, belonephobia, and mental disorders. DEX has relatively less influence on the respiratory system than other sedative drugs such as propofol, benzodiazepines, or opioids, which cause respiratory depression [9,10]. The highlight of this study is that GA can be replaced with DEX for sedation in some psychiatrically/neurologically difficult cataract cases from the point of view of hemodynamic less stress and less consumption of time. The hemodynamic changes observed in the GA group were mainly caused by intubation and extubation techniques, which were commonly seen in patients sedated with GA. The necessary time which was not influenced by surgical time was quite significantly shorter in DEX groups. This result might be appeared by the following reasons. At first, GA was required anesthesiologist's procedure and, after then, ophthalmologist could start to prepare for surgery such as confirming the body position and disinfection procedure. At second, some of the patients in DEX group were not required complete unconsciousness at the beginning of the surgery. So surgery could start to operate earlier than GA. Furthermore, the infusion of DEX was usually stopped at approaching to the finish of the surgery by the surgeons' consideration. Finally, the stability of the homodynamic status at the leaving from the operation theater was relatively easily acquired among DEX groups. In other words, DEX enabled us to treat many patients with cataract efficiently and safely within a limited time.

The most frequent reason for using GA or sedation was cognitive impairment. Therefore, cataract surgery under sedation with DEX may be a very useful tool in these aging societies. Furthermore, since many elderly patients are anxious about receiving GA, sedation with DEX may be more comfortable for them from both physical and psychological aspects. In our study, about 4% (81/1935) of patients who underwent cataract surgery seemed unlikely to control their body motion due to their psychological situation. DEX has been used in intensive care units for more than 20 years and, so, its high level of safety is known in clinical practice. In our experience, DEX can also relieve the blinking reflex in patients with Parkinson disease or ocular nystagmus.

There are some reports that compare DEX with midazolam, ketamine, propofol, or remifentanyl for use in cataract surgery. It was reported that DEX reduced intra-ocular pressure and produced a short-action sedative effect with marginal cardiovascular effects compared with midazolam [12]. The reducing intraocular pressure

made cataract surgery safety. Another study concluded that DEX was a more suitable sedative drug than remifentanyl because of its more favorable postoperative cognitive status, and it's fewer adverse effects on the cardiovascular and respiratory systems [13]. These reports support our results from the point of view of efficacy and safety. While Yagan et al. reported that sedation with the ketamine-propofol combination was more efficient than sedation with DEX; DEX was preferred in light of the hemodynamic and respiratory adverse effect [14]. From our experience, systemic monitoring showed an overall steady state in patients sedated with DEX compared to GA. As this is a retrospective study, the homodynamic stress was only analyzed by BP, HR and SpO<sub>2</sub> which was measured routinely during the operation time. It should be better to analyze additionally such as postoperative cognitive dysfunction, the consumption of analgesics after surgery, the length of stay in the hospital as a homodynamic stress. So we must state that this study is not entirely conclusive evidence only to measure these limited factor.

In the current study, 6 patients with dementia planned to receive DEX during their first visit to the hospital; however, topical anesthesia rather than DEX was used based on the surgeons' consideration at the time of operation. Like these cases, surgeons could decide whether or not to use DEX, after observing patients' situation. This fact implied that some of the patients received GA might not need GA, essentially. One mental retardation case awoke during the operation sedated with DEX was used and was converted to GA. This case is a 65-year-old male patient. Surgical preparations such as disinfection procedure were started under an insufficient sedative condition for this patient. Maybe we ought to take more time to sedate and confirm to fall asleep and then start operation in such young, male and mental retardation case. These 7 cases were excluded from the analysis. When patients cannot control their body movement or their psychological condition is not calmed down enough even with DEX, the anesthesia should be immediately converted to GA under the observation of an anesthesiologist.

## Conclusion

In conclusion, administration of DEX during cataract surgery decreased hemodynamic stress and shortened necessary time. It may have a favorable impact on patients' systemic conditions and profound economical effect.

## References

1. Ishii K, Kabata T, Oshika T (2008) The impact of cataract surgery on cognitive impairment and depressive mental status in elderly patients. *Am J Ophthalmol* 146: 404-409.
2. Grisso JA, Kelsey JL, Strom BL, Chiu GY, Maislin G, et al. (1991) Risk factors for falls as a cause of hip fracture in women. The Northeast Hip Fracture Study Group. *N Engl J Med* 324: 1326-1331.
3. Klein BE, Klein R, Lee KE, Cruickshanks KJ (1998) Performance-based and self-assessed measures of visual function as related to history of falls, hip fractures, and measured gait time. The Beaver Dam Eye Study. *Ophthalmology* 105: 160-164.
4. Tamura H, Tsukamoto H, Mukai S, Kato T, Minamoto A, et al. (2004) Improvement in cognitive impairment after cataract surgery in elderly patients. *J Cataract Refract Surg* 30: 598-602.
5. Muttu S, Liu EH, Ang SB, Chew PT, Lee TL, et al. (2005) Comparison of dexmedetomidine and midazolam sedation for cataract surgery under topical anesthesia. *J Cataract Refract Surg* 31: 1845-1846.
6. Kamibayashi T, Maze M (2000) Clinical uses of alpha2 -adrenergic agonists. *Anesthesiology* 93: 1345-1349.

7. Gerlach AT, Dasta JF (2007) Dexmedetomidine: an updated review. *Ann Pharmacother* 41: 245-252.
8. Alhashemi JA (2006) Dexmedetomidine vs midazolam for monitored anaesthesia care during cataract surgery. *Br J Anaesth* 96: 722-726.
9. Esmaoglu A, Yegenoglu F, Akin A, Turk CY (2010) Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. *Anesth Analg* 111: 1548-1551.
10. Marhofer D, Kettner SC, Marhofer P, Pils S, Weber M, et al. (2013) Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: a volunteer study. *Br J Anaesth* 110: 438-442.
11. Arain SR, Ebert TJ (2002) The efficacy, side effects, and recovery characteristics of dexmedetomidine versus propofol when used for intraoperative sedation. *Anesth Analg* 95: 461-466.
12. Virkkila M, Ali-Melkkila T, Kanto J, Turunen J, Scheinin H (1994) Dexmedetomidine as intramuscular premedication for day-case cataract surgery. A comparative study of dexmedetomidine, midazolam and placebo. *Anaesthesia* 49: 853-858.
13. Kermany MP, Dahi M, Sharif RY, Radpay B (2016) Comparison of the Effects of Dexmedetomidine and Remifentanyl on Cognition State After Cataract Surgery. *Anesth Pain Med* 6: e33448.
14. Yagan O, Karakahya RH, Tas N, Kucuk A (2015) Comparison of Dexmedetomidine Versus Ketamine-Propofol Combination for Sedation in Cataract Surgery. *Turk J Anaesthesiol Reanim* 43: 84-90.