

Full Length Research Paper

Impact of Dexmedetomidine on Hemodynamic Stability, Cerebral State Index, and Postoperative Wakefulness in Geriatric Patients Undergoing Total Hip Replacement with General Anesthesia

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This study aimed to investigate how dexmedetomidine (Dex) administration influences hemodynamics [systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR)] and cerebral state index (CSI) in elderly patients undergoing total hip replacement (THR) surgery with general anesthesia. Patients aged sixty (60) years undergoing THR surgery and general anesthesia were recruited and randomly divided into an observation and a control group. The 30 patients in the observation group received intravenous 0.3 µg/kg Dex via an implanted minipump, while the control group received saline. Hemodynamic parameters including SBP, DBP, HR, and CSI were recorded at various time points: start of surgery (T0), start of drug administration (T1), 10 minutes post-drug (T2), skin incision (T3), 30 minutes post-incision (T4), extubation (T5), and 30 minutes after extubation (T6). Additionally, waking time, extubation time, and vigilance/sedation (OAA/S) scores 30 minutes post-surgery were documented. In both groups, SBP, DBP, and HR decreased at T2 and increased at T5, showing significant differences from T0 ($P<0.05$). The observation group exhibited lower SBP, DBP, and HR at T5 and T6 compared to the control group ($P<0.05$). CSI decreased at T2 and increased at T5 in both groups, with significant differences from T0 ($P<0.05$). The observation group also had lower CSI values at T5 and T6 relative to the control group ($P<0.05$). Furthermore, the observation group had shorter extubation and waking times, along with higher vigilance/sedation (OAA/S) scores compared to the control group ($P<0.05$). Dex administration stabilizes hemodynamics (SBP, DBP, and HR) and reduces CSI in elderly patients undergoing THR surgery with general anesthesia, also decreasing extubation and waking times post-surgery.

Key words: Dexmedetomidine, aged patients, total hip replacement, general anesthesia, hemodynamics, cerebral function index, extubation time, waking time.

INTRODUCTION

Total hip replacement (THR) is used in the treatment of avascular necrosis, femoral neck fractures, hip osteoarthritis, and rheumatoid arthritis (Learmonth et al., 2007; Lang et al., 2008; Ranawat and Ranawat, 2005;

Temple, 2004). THR often brings big trauma and blood loss, and requires the use of bone adhesives (Wojciechowski et al., 2008). Additionally, in aged patients, THR can cause complications such as hypertension and coronary heart disease. The proper and deep anesthesia procedures observed during surgery are therefore critical in improving the success rate and reducing complications of the surgery. Dexmedetomidine (Dex) is a newly developed adrenergic α_2 receptor

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Table 1. The hemodynamics changes in two groups ($\bar{x} \pm s$).

Hemodynamics	Group	T0	T1	T2	T3	T4	T5	T6
SBP (mmHg)	Observation	138.64±8.94	138.93±8.87	128.71±8.30*	106.05±6.84*	98.52±6.29*	113.52±7.32*▲	114.58±7.39*▲
	Control	138.43±8.93	139.65±9.01	130.89±8.44*	100.91±6.51*	97.81±6.31*	140.76±9.08	141.73±9.14
DBP (mmHg)	Observation	88.28±5.64	89.46±8.73	80.90±8.23*	66.81±6.31*	62.83±6.06*	73.54±*▲ 8.80	70.48±8.78*▲
	Control	87.59±5.65	88.69±8.10	81.60±7.71*	68.82±5.86*	64.03±5.68*	89.68±8.17	87.56±8.23
HR (per minute)	Observation	81.85±5.28	82.52±7.86	76.01±7.48*	71.09±5.68*	69.39±5.51*	71.81±7.92*▲	72.73±7.98*▲
	Control	81.13±5.18	81.62±7.29	78.64±6.94*	73.74±5.22*	70.23±5.11*	92.02±7.28*	96.80±7.40*

*, $P < 0.05$ compared to T0; ▲, $P < 0.05$ compared to control group.

agonist, showing good sedation effects without inhibition on the respiratory activities (Kunisawa, 2011; Mantz, 2011; Yuen, 2010). Dex has therefore been used for aged patients in some previous studies (Rozet et al., 2006; Baddigam et al., 2005). In the present study, we examined the potential use of Dex in aged patients under general anesthesia for THR surgery by monitoring the hemodynamics including systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR), as well as, cerebral state index (CSI) before, during and after the Dex administration. The effects of Dex administration on the extubation time and waking time after surgery were also studied.

MATERIALS AND METHODS

Clinical data

During May, 2006 to May, 2011, 60 aged ASA I to II patients undergoing THR surgery and general anesthesia were recruited and randomly assigned into observation group and control group. The sixty patients comprised 42 males and 18 females, aged 65 to 79 years old (mean 63.41 ± 6.27 years) and weighing 56 to 86 kg with an average weight of 68.61 ± 8.1 kg. ASA I class comprised 39 cases, and ASA II class comprised 21 cases. The two groups showed no differences in composition of patients. The study was approved by ethic committee of medical research using human subjects in the Department of Anesthesiology, Renmin Hospital, and has the written consent from all patients.

Drug administration

The 30 patients in the observation group were given intravenous (0.3 $\mu\text{g/kg}$) Dex through an implanted minipump, and the control group patients were given with Saline. The hemodynamics including SBP, DBP, and HR, as well as, CSI were recorded at the start of the surgery (T0), start of the drug administration (T1), 10 min with drug (T2), skin incision (T3), 30 min after skin incision (T4), extubation (T5), and 30 min after extubation (T6). The waking time, extubation time, and vigilance/sedation (OAA/S) score 30 min after surgery were also recorded.

Statistics

The data are presented with mean \pm standard deviation and the

data analysis was done using SPSS13.0 statistical analysis software (Chicago, US). T test was used for comparisons between two groups, and analysis of variance (ANOVA) was used for comparisons among multiple groups. $P < 0.05$ was determined as statistically significant.

RESULTS

The hemodynamics in two groups

In both groups, the SBP, DBP and HR decreased at T2 and began to increase at T5, with significant differences from T0 ($P < 0.05$). In the observation group, the SBP, DBP and HR showed lower values at T5 and T6 compare to the control group ($P < 0.05$) (Table 1).

Cerebral state index changes in the two groups

In both groups, the CSI decreased at T2 and began to increase at T5, with significant differences from T0 ($P < 0.05$). In observation group, the CSI showed lower values at T5 and T6 compare to the control group ($P < 0.05$) (Table 2).

The extubation time, recovery time, OAA/S score in two groups

The observation group showed decreased extubation time and waking time as well as a higher OAA/S score compare to the control group ($P < 0.05$) (Table 3).

DISCUSSION

During the surgery, the aged patients often show strong stress-response, leading to severe complications in the cardiovascular, respiratory, and nervous system. This could at least partially attribute to the anesthesia status. The present study investigated the effects of using Dex prior to surgery on hemodynamics, cerebral state function, and after surgery waking time in order to

Table 2. The cerebral state index changes in two groups ($\bar{x} \pm s$).

Group	n	T0	T1	T2	T3	T4	T5	T6
Observation	30	95.27±6.14	95.28±5.24	70.34±4.99*▲	40.73±3.79*▲	40.93±3.67*▲	91.92±5.28*▲	92.49±5.32*▲
Control	30	94.75±6.05	95.41±4.86	92.76±4.63	70.49±3.51*	71.82±3.37*	76.01±4.90*	80.53±4.89*

*, $P < 0.05$ compared to T0; ▲, $P < 0.05$ in compared to control group.

Table 3. The extubation time, wakening time and OAA/S score in two groups ($\bar{x} \pm s$).

Group	n	Extubation time	Wakening time	OAA/S score
Observation	30	14.22±1.11*	13.82±0.94*	4.29±0.27
Control	30	19.56±1.05	21.61±0.88	2.87±0.24*

*, $P < 0.05$ compared to control group.

explore the potential pharmacological effects of Dex in clinical practices of general anesthesia for aged patients. Dex is a highly selective α_2 adrenergic receptor agonist, and had been shown to be antihypertensive, sedative, analgesic, and anti-anxious in past applications (Mantz, 2011; Arcangeli, 2009; Carollo et al., 2008; Chrysostomou and Schmitt, 2008). The use of Dex could modulate the cardiovascular, respiratory and nervous system to reduce the metabolism load of the tissue, in order to alleviate the stress response.

Our results showed that in observation group, the decrease of SBP, DBP and HR were more pronounced compare to the control group. This is inconsistent with previous studies that indicated the strong effects of Dex in the cardiovascular system, including the inhibition of hypertension and abnormal HR in the perioperative period, the increase of the blood flow ratio in the control/ischemic area (Tobias et al., 2011; Gertler et al., 2001). Additionally, the use of Dex decreased the CSI more pronouncedly in the observation group, suggesting that Dex could

enhance the depth of anesthesia.

Previous study suggested that Dex produced sedation in the patients, with better cooperation with the physician (Arcangeli, 2009; Chrysostomou and Schmitt, 2008). In the present study, we found that in Dex administration (observation) group, the extubation time, wakening time after surgery were shorter than control group, with higher OAA/S score, suggesting for better neuroprotective effects.

In conclusion, the preoperative use of Dex on aged patients under general anesthesia for THR surgery could maintain perioperative hemodynamic stability, reduced the CSI, increase the depth of anesthesia, decrease the extubation time, and reduce the post-operative recovery time. This study suggests the potential application of Dex in other types of surgeries for aged patients.

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