A Comparison of Dexmedetomidine and Propofol in Patients Undergoing Electrophysiology Study

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Background: *Dexmedetomidine provides profound levels of sedation without affecting cardiovascular and respiratory stability based on its pharmacological profile. It may be a valuable sedative for procedures with minimal to mild pain. Electrophysiology study (EP study) is a mildly painful procedure that requires conscious sedation. The authors hypothesized that dexmedetomidine would cause lower respiratory and cardiovascular depression than propofol during equal sedation level in an electrophysiology study.*

Material and Method: *The present study protocol was approved by the clinical research ethics committee at Ramathibodi Hospital. Thirty-four patients were randomly allocated into two groups to receive either dexmedetomidine or propofol for an electrophysiology study. Patients in the dexmedetomidine group received a loading dose of dexmedetomidine (0.5 mcg/kg) infused over 10 minutes followed by 0.4 mcg/kg/h. Each patient in the propofol group received propofol 1mg/kg over 10 minutes followed by 3mg/kg/h. All patients received pethidine (0.5 mg/kg) before the initiation of EP study. Sedation was determined using the Modified Observer's Assessment of Alertness/Sedation (MOAA/S). The Modified Observer's Assessment of Alertness/Sedation scores, hemodynamic and respiratory variables were recorded regularly during the EP study.*

Results: *Thirty-four patients were enrolled in the present study. The Modified Observer's Assessment Alertness/Sedation values were similar in both groups. Respiratory rate values with dexmedetomidine were significantly higher than those in the propofol group ($p = 0.048$) and the oxygen supplement in the dexmedetomidine group were significantly lower than those in the propofol group ($p<0.001$). Moreover, mean arterial blood pressure values of dexmedetomidine at the five and 15-minute were significantly higher than those of the propofol group ($p = 0.024$). No incidence of severe bradycardia or hypotension was found in both groups.*

Conclusion: *The present study demonstrated that comparable sedation could be achieved by a combination of pethidine with either dexmedetomidine or propofol during EP study. Dexmedetomidine group provided more hemodynamic and respiratory stability than propofol group.*

Keywords: *Dexmedetomidine, Propofol, Electrophysiology study*

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Combination of a sedative hypnotic drug and an opioid analgesic are frequently used to provide patient comfort, analgesia, and sedation during several short operation procedures. Nowadays, propofol is widely used as a sedative hypnotic drug to provide procedural sedation. However, it may cause some respiratory depression, an effect that can be amplified in the presence of opioids.

During the process of electrophysiological study (EP study), ablation will provoke retrosternal chest pain. Deep sedation will be necessary to suppress this type of pain but the common problem is respiratory depression, which is the effect of deep sedation by using propofol[1].

Dexmedetomidine is a potent, highly selective α2-adrenoreceptor agonist having a distribution half-life of approximately eight minutes and a terminal half-life of 3.5 hours. At therapeutic doses, dexmedetomidine adequately provides levels of sedation with minimal effect on cardiovascular and respiratory stability[2,3]. In addition, based on its pharmacological profile, it may be a valuable sedative for procedures with minimal to mild pain[4-6].

The authors hypothesized that dexmedetomidine would cause lower respiratory depression than propofol during equal sedation level. This clinical study was designed to compare the

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hemodynamic, respiratory effects and sedative level between dexmedetomidine and propofol in combination with pethidine during conscious sedation in EP study.

Material and Method

The present study protocol was approved by the clinical research ethic committee at Ramathibodi Hospital. All patients were adult, 18 years or older, who were scheduled for electrophysiology study (EP study). Exclusion criteria included patients with psychiatric disorder, with increased likelihood that the patient would be uncooperative during the procedure, patients with a history of sleep apnea, patients with morbid obesity, and those with second or third- degree AV block.

In the EP study room, when patients arrived, vital signs such as heart rate, arterial blood pressure, and pulse oxygen saturation were recorded at baseline and then every 2.5 minutes thereafter. Patient's sedation level was assessed by using the Modified Observer's Assessment of Alertness/Sedation (MOAA/S): 5 = response readily to name spoken in normal tone (awake/alert), 4 = lethargic response to name spoken in normal tone, 3 = response only after name spoken loudly or repeated, 2 = response after mild prodding or shaking, 1 = does not respond to mild prodding or shaking (asleep/unarousable) at baseline and then every 5 min until the end of the procedure.

All patients were randomized into either the dexmedetomidine or the propofol group. Patients in the dexmedetomidine group received a loading dose of dexmedetomidine (0.5 mcg/kg) infused over 10 min and then followed by 0.4 mcg/kg/h. Each patient in the propofol group received propofol 1 mg/kg over 10 min after that was followed by 3 mg/kg/h. Both drugs were adjusted to achieve adequate sedation level (MOAA/S = 3); infusion doses of the test drugs were increased by 50% if sedation was inadequate (MOAA/S = 4 or more) and decreased by 50% if patients were MOAA/S <3. Study drugs were stopped for two minutes, and when the MOAA/S scores 3 or higher, the present study drugs were given. All patients received pethidine 0.5 mg/kg before the initiation of the EP study.

During the procedure, if SpO_2 was 95% or less, and bradypnea (RR <10) were detected, supplement of 100% oxygen (3L/min) was administered via nasal cannula. In case of bradycardia (50/min) and BP <90/60 mmHg, 0.3 mg atropine and 0.9% saline was given.

As the primary outcome of the present study was the respiratory rate between two groups, so, to demonstrate a 20% difference in respiratory rates with 80% of power and type-1 error of 0.05, the authors need 17 patients for each group.

Data were presented as mean, SD and percentage. Demographics were compared using Student's t-test and Chi-square test as appropriate. The conformity of the data to a normal distribution was confirmed by Shapiro-Wilk test. A two-way repeated measures ANOVA followed by the Tukey's post-hoc test was used to examine differences between dexmedetomidine and propofol groups. The SPSS statistical software was used for all analyses and p-value <0.05 were considered statistically significant.

Results

Thirty-four patients were enrolled into the present study, seventeen in each group. We found no differences of age, gender, or weight between two groups. However, the incidences of oxygen supplement in propofol group was significantly higher than in dexmedetomidine group ($p<0.001$) as shown in Table 1.

The authors found no significant differences of the Modified the Observer's Assessment of Alertness/Sedation (MOAA/S) values between two groups ($p = 0.059$) as shown in Fig. 1. The MAP values were found to be lower after baseline assessment. MAP value were significantly differences of between two groups ($p = 0.024$), (Fig. 2).

There was no significant difference in SpO_2 values between dexmedetomidine and propofol after given oxygen supplement ($p = 0.448$) (Fig. 3). RR values during sedation were lower than those at the baseline in both groups. RR values of dexmedetomidine group were significantly higher than those of the propofol group ($p = 0.048$), (Fig. 4).

In the dexmedetomidine group, HR values were significantly lower than those in the propofol group ($p<0.001$), (Fig. 5). The incidence of severe

Table 1. Demographic data of the study groups

	Dexmedetomidine (n = 17)	Propofol (n = 17)
Age (yr)	48±14	45±14
Gender (male/female)	7/10	3/14
Weight (kg)	61±10	66±13
Oxygen supplementation (%)	6 (35%)	11 (64%)*

* $p<0.001$

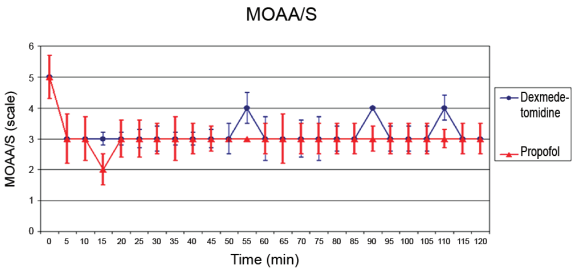

Fig. 1 The Modified Observer's Assessment Alertness/ Sedation (MOAA/S) values at baseline and during sedation. There were no significant difference in MOAA/S between two groups ($p>0.05$). Data are expressed as mean±SD.

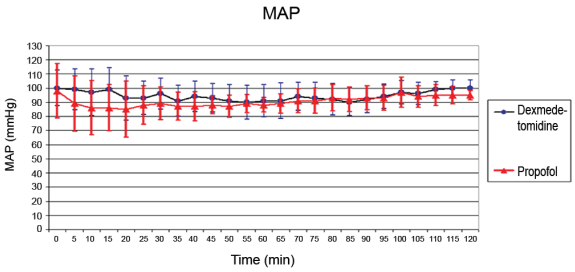

Fig. 2 MAP values at baseline and during sedation. Patients receiving dexmedetomidine had significantly higher MAP compared with the propofol group at 5-15 mins ($p<0.05$). Data are expressed as mean±SD.

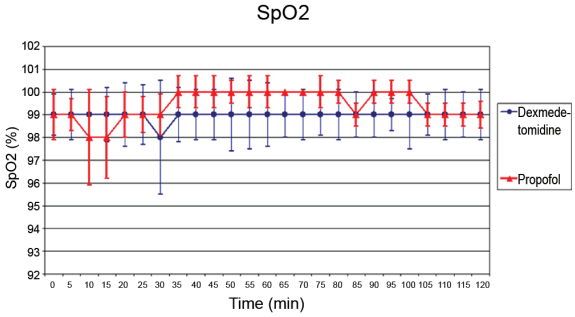

Fig. 3 The oxygen saturation value at baseline and during sedation. There was no significant difference in SpO_2 values between dexmedetomidine and propofol after given oxygen supplement ($p>0.05$). Data are expressed as mean±SD.

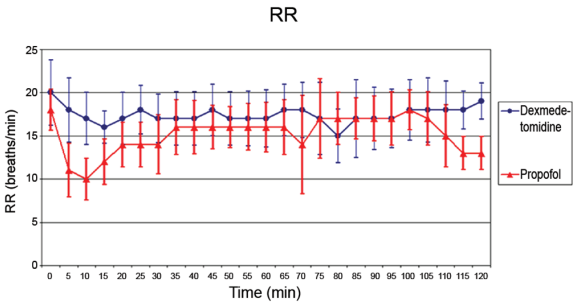

Fig. 4 RR value at baseline and during sedation. Patients receiving dexmedetomidine had significantly higher RR compared with the propofol group at 5-30 mins ($p<0.05$). Data are expressed as mean±SD.

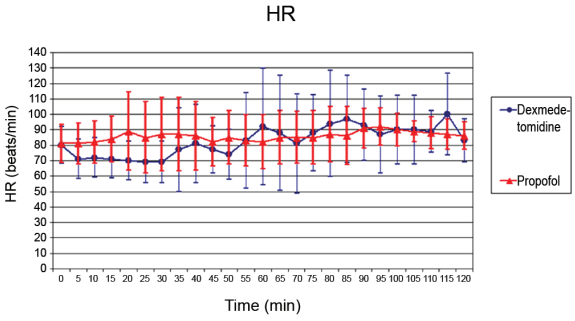

Fig. 5 HR value at baseline and during sedation. Patients receiving dexmedetomidine had significantly lower HR compared with the propofol group at 5-30 mins ($p<0.05$). Data are expressed as mean±SD.

bradycardia, and hypotension in both groups were not found in the present study.

Discussion

The purpose of the present study was to compare the sedative effect and hemodynamic response between dexmedetomidine and propofol for sedation during EP study. The authors found that dexmedetomidine, combined with pethidine, could provide adequate sedation during EPS. The RR was more rapid with dexmedetomidine than propofol. MAP was higher in dexmedetomidine, and HR was less with dexmedetomidine than propofol, but the decrease in HR did not require treatment in either group.

Kaygusuz et al found that the combination of dexmedetomidine and fentanyl is effective for sedation during ESWL[7]. Their study used initial loading dose 1 mcg/kg over 10 minutes with dexmedetomidine. In contrast to the present study, dexmedetomidine was given only 0.5 mcg/kg at the beginning and was combined with pethidine 0.5 mg/kg IV to enhance the analgesic effects. Moreover, the present study compared between dexmedetomidine with pethidine and propofol with pethidine for sedation during EP study. In the present study, the authors demonstrated that adequate sedative level could be achieved at lower initial loading dose of dexmedetomidine than

in the previous study. Furthermore, the authors demonstrated that comparable sedation (MOAA/S) could be achieved with either dexmedetomidine or propofol but dexmedetomidine may provide advantage over propofol such as preservation of respiratory function (higher RR, oxygen saturation, and lower oxygen supplementation) and more hemodynamic stability.

In present study, dexmedetomidine and propofol resulted in reduction in MAP from baseline values. Several previous studies have reported that there is similar trend of decrease in MAP between both drugs[7,8]. However, the authors found that the diminution of MAP in dexmedetomidine was less than those in propofol. The authors speculated that the different results were caused by lower loading dose of dexmedetomidine, which was only 0.5 mcg/kg over 10 minutes. Riker et al reported loading doses of 0.4 mg/kg reduce the adverse events[9]. In addition, the decrease in MAP did not require treatment in either group.

HR values in the dexmedetomidine group at five to 40 minutes were significantly lower than those in the propofol group. The several previous studies reported the effect of dexmedetomidine induced bradycardia after initial loading of this drug. Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, acts as a sympatholytic effect and results in bradycardia and hypotension[10-12]. Ferdi et al have shown in their study that none of the patients who experienced bradycardia required treatment. The result of their study appears relevant to the present study as well[13].

One of the objectives of the present study was to explore the possibility of better preservation of respiratory function with the use of dexmedetomidine compared to propofol. Several studies reported using dexmedetomidine as a sedative drug had no airway obstruction and respiratory depression[10,11]. Arain SR et al have reported no significant decrease in RR in both groups[14]. In contrast to the present study, RR and oxygen saturation in the propofol group were lower than the dexmedetomidine group. This may be related to sedative doses of propofol, which have minimal depressant effects on tidal volume and minute ventilation, depress the hypoxic ventilatory response, and cause more frequent and longer apnea[13,15]. Because the authors added pethidine to the management of all patients, its effect should also be considered to impact respiratory function. In addition, the effects of sedatives on respiratory depression may be widely influenced by the balance between pain and the effects of the administered sedatives/opioid.

Conclusion

The present study demonstrated that comparable sedation could be achieved with either the combination of dexmedetomidine and pethidine or propofol and pethidine during EP study.

The dexmedetomidine group provided more hemodynamic and respiratory stability than the propofol group.

Potential conflicts of interest

None.

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เปรียบเทียบผลของ dexmedetomidine และ propofol เพื่อการตรวจวิเคราะห์ไฟฟ้าหัวใจ

นฤมล ประจันพาณิชย์, วรพจน์ อภิญญาชน, วิชัย อิทธิชัยกุลฑล, อรวรรณ มูลตรีภักดี, อัมพร จิตอารี

ภูมิหลัง: *Dexmedetomidine เป็นยาคลายกังวลที่สามารถใช้คลายกังวลได้หลายระดับ โดยไม่มีผลกระทบต่อระบบการทำงานของหัวใจ หลอดเลือด และระบบการหายใจ นอกจากนี้ dexmedetomidine ยังใช้ในการคลายกังวลสำหรับการทำหัตถการทางการแพทย์ที่มีความปวดระดับน้อยถึงปานกลาง การทำหัตถการตรวจวิเคราะห์ไฟฟ้าหัวใจจำเป็นต้องให้ยาคลายกังวลและลดปวดเนื่องจากเป็นหัตถการที่ก่อให้เกิดความปวดระดับน้อย การศึกษานี้จึงมีสมมุติฐานว่า dexmedetomidine มีผลกระทบต่อระบบหัวใจ หลอดเลือด และระบบหายใจ น้อยกว่า propofol ที่ระดับการคลายกังวลที่เท่ากัน ในผู้ป่วยที่มารับการตรวจวิเคราะห์ไฟฟ้าหัวใจ*

วัสดุและวิธีการ: *ผู้ป่วย 34 ราย ที่มารับการตรวจวิเคราะห์ไฟฟ้าหัวใจแบบสุ่ม ด้วยการให้ยา dexmedetomidine หรือ propofol ผู้ป่วยในกลุ่ม dexmedetomidine จะได้รับยา 0.5 มคก./กก. ในเวลา 10 นาที จากนั้นหยดเข้าหลอดเลือดดำ 0.4 มคก./กก./ชม. ส่วนผู้ป่วยกลุ่ม propofol จะได้รับยา 1 มก./กก. และหยดเข้าหลอดเลือดดำ 3 มก./กก./ชม. ผู้ป่วยทุกรายจะได้รับ pethidine ขนาด 0.5 มก./กก. ก่อนเริ่มทำหัตถการ ระหว่างการทำหัตถการ ผู้ป่วยทั้งสองกลุ่มได้รับการประเมินระดับความรู้สึกด้วย The Modified Observer's Assessment of Alertness/Sedation และประเมินการทำงานของระบบหัวใจ หลอดเลือด และอัตราการหายใจ*

ผลการศึกษา: *The Modified Observer's Assessment of Alertness/Sedation ของผู้ป่วยทั้ง 2 กลุ่ม ไม่ต่างกัน อัตราการหายใจ และความดันเลือดใน 5-15 นาทีแรก ของผู้ป่วยกลุ่ม dexmedetomidine มีค่าสูงกว่ากลุ่ม propofol อย่างมีนัยสำคัญ การให้ออกซิเจนในกลุ่ม propofol มีค่าสูงกว่ากลุ่ม dexmedetomidine อย่างมีนัยสำคัญด้วยเช่นกัน ไม่พบอัตราการเต้นของหัวใจช้า และความดันเลือดต่ำมากในผู้ป่วยทั้ง 2 กลุ่ม*

สรุป: *ผู้ป่วยที่มารับการตรวจวิเคราะห์ไฟฟ้าหัวใจสามารถให้ dexmedetomidine หรือ propofol ร่วมกับ pethidine เพื่อทำหัตถการได้ไม่ต่างกัน*
