



Sedation for magnetic resonance imaging in the prone position - A report of four cases -

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Background: Magnetic resonance imaging (MRI) is a useful tool, but it can be difficult to perform in those with claustrophobia as it requires being enclosed in a noisy cylindrical space. Being in the prone position is essential to spread breast tissue. However, sedation in a prone position is challenging because of the possibility of respiratory depression and the difficulty in manipulating the airway.

Case: Four patients with claustrophobia were sedated using dexmedetomidine, has minimal effect on respiration. Dexmedetomidine also enables the patient's cooperation in assuming the prone position while infusing loading time. But dexmedetomidine requires a longer time to reach moderate sedation, an intermittent bolus of midazolam was required for rapid induction of moderate sedation. All exams were conducted successfully without any complications.

Conclusions: Administering dexmedetomidine and a midazolam bolus at the appropriate dose and timing will render MRI examinations in the prone position safe and satisfactory, without respiratory complications.

Keywords: Case report; Conscious sedation; Magnetic resonance imaging; Patient safety; Prone position.

Magnetic resonance imaging (MRI) is a useful diagnostic imaging tool, but premature termination of MRI examinations due to claustrophobia is quite common. Sedation is essential to complete the examination for them [1,2]. Breast MRI takes more than 30 min to complete and requires the patient to be in a prone position, essential for identifying the exact location of a lesion by spreading the breast tissue. Sedation in the prone position can increase the risk of respiratory complications [3], and simple manipulations such as jaw-thrust maneuver or insertion into the oral or nasal airway are not possible; thus, more attention is required to

maintain patient safety. In addition to the risk of cardiorespiratory complications due to sedation, sedation in an MRI suite has several risks, such as impaired immediate access to the patient for intervention and inability to use the standard airway equipment, such as standard laryngoscopes, videoscopes, or other devices assisting airway access, due to the magnetic field.

Dexmedetomidine acts on the alpha-2 receptor to produce a natural sleep-like condition [4], and is thus used for MRI sedation in patients with claustrophobia [5,6]. Moreover, because dexmedetomidine has little effect on respira-

tion [3,4,6,7], it can be used in pediatric patients [8,9] or patients with respiratory problems [10,11], even in the prone position [3].

However, the onset of sedation is slow [5,9], so the use of dexmedetomidine for ambulatory sedation is limited [12]. Also, dexmedetomidine can achieve moderate and arousable sedation, careful attention is required during examination because loud noises in the MRI machine can be an irritating and awakening stimulus. For these reasons, we administered rescue midazolam instead of increasing the infusion rate of dexmedetomidine. We report our experience with four cases of MRI-associated claustrophobia during examination of the breast under monitored anesthesia care using dexmedetomidine and midazolam.

CASE REPORT

Publication of this case reports was approved by the Institutional Review Board (no. 2020-04-027) and the requirement for informed consent was waived because all data were obtained by retrospective chart review.

Case 1

The patient was a 59-year-old female with hypertension and very severe claustrophobia (height, 153 cm; weight, 66 kg; body mass index [BMI], 28.2 kg/m²). After baseline vital signs were measured, dexmedetomidine (Dextomine[®], Hanlim Pharmaceuticals Inc., Korea) infusion was started at a loading dose of 1 µg/kg over 10 min using a syringe pump. Oxygen was supplied via a nasal cannula at a rate of 5 L/min. She complained of anxiety when in the prone position but managed to place her breast within the recesses of an 8-channel breast coil[®] (GE Healthcare, USA) (Fig. 1). However, she could not tolerate placing her face on the head rest of the coil; thus, 1 mg midazolam (Vascam[®], Hana Pharmaceuticals, Korea) was administered to induce rapid sedation effect. After injection of midazolam, her Modified Observer's Assessment of Alertness/Sedation (MOAA/S) scale became 3. The total preparation time was 13 min. After the loading dose, continuous infusion of dexmedetomidine was maintained at 0.6 µg/kg/h. Initially the noise of the machine caused the patient to move, so an additional 1 mg midazolam was administered. There were no bradycardia or hypotension events during MRI, and regular self-respiration was confirmed by end-tidal CO₂ monitoring using capnography (Expression MR200[®], Philips Healthcare, USA). The total ex-

amination time was 40 min, and total anesthesia time was 55 min. At the end of the MRI examination, her MOAA/S scale was 3, and self-respiration was well maintained; therefore, she was transported to the post-anesthesia care unit (PACU) and discharged without any complications after recovering for 55 min in the PACU.

Case 2

The patient was a 54-year-old female without underlying disease (height, 163 cm; weight, 47 kg; BMI, 17.7 kg/m²). She complained of anxiety and fear about the MRI examination but was more cooperative than the previous patient. Similar to the previous sedation, the same dose of dexmedetomidine was infused while in the prone position. Because the posture was completed within 5 min and her MOAA/S scale was 5, 2 mg midazolam was administered for rapid induction of sedation. Even though her MOAA/S scale became 2, she showed movement due to noise of the MRI, so an additional 1 mg of midazolam was administered. After that, self-respiration was well maintained without any complications until the examination was completed. The total examination time was 45 min, and total anesthesia time was 55 min. She was transported to the PACU, but after 30 min, she experienced asymptomatic hypotension (systolic blood pressure < 80 mmHg) despite having a MOAA/S scale of 5. Ephedrine (5 mg) was administered twice, and she was discharged after recovering for 70 min in the PACU.

Case 3

The patient was a 41-year-old female without underlying disease (height, 165 cm; weight, 59 kg; BMI, 21.7 kg/m²). Se-



Fig. 1. Patient position assist device for breast MRI, including an 8-channel breast coil[®] (GE Healthcare, USA). MRI: magnetic resonance imaging.

dation was considered due to anxiety and fear during her previous breast MRI examination. As in the previous cases, the same dose of dexmedetomidine was administered, with a total preparation time of 13 min. At 10 min of loading dose, her MOAA/S scale was 4, so 1 mg midazolam was administered. However, an additional 1 mg midazolam was required because her MOAA/S scale did not decrease. Once an MOAA/S scale of 2 was confirmed, the MRI examination was started. Self-respiration was well maintained without complications. The total examination time was 47 min, and total anesthesia time was 60 min. Immediately after completing the examination, her MOAA/S scale was 4, but she did not complain of any discomfort. The patient was discharged without complications after recovering for 32 min in the PACU.

Case 4

The patient was a 52-year-old female with hypertension and ulcerative colitis (height, 158 cm; weight, 59 kg; BMI, 23.6 kg/m²). She requested sedation due to claustrophobia, so a loading dose of dexmedetomidine (1 µg/kg) was infused while in the prone position. The total preparation time was 10 min, but 10 min after the loading dose, her MOAA/S scale was 5, so an additional 2 mg midazolam was administered for rapid sedation. An additional 1 mg of midazolam was administered before the start of examination to prevent movement from noise despite a MOAA/S scale of 3. Self-respiration was well maintained without any complications, but the continuous dose of dexmedetomidine was increased from

0.6 µg/kg/h to 0.7 µg/kg/h due to slight movement at the end of the examination. The total examination time was 50 min and the total anesthesia time 65 min. After completing the examination, the MOAA/S scale was 3, and she was discharged without complications after recovering for 25 min in the PACU.

DISCUSSION

In our center, a moderate level of sedation is considered appropriate for successful breast MRI examination, and this was measured using MOAA/S scale, with a target scale of 2 or 3 according to our center's sedation guideline. The use of dexmedetomidine is increasing as it has minimal effect on respiration. In our four cases (Table 1), it took an average 10.25 min (5–13 min) for completion of the posture (Table 2), longer than the dexmedetomidine loading time of 10 min. After assessing the level of sedation using MOAA/S scale, rescue midazolam was required in all patient, because their MOAA/S scales were 4 to 5 (corresponding to minimal sedation) immediately after the completion of posture. All patient were quickly sedated to an MOAA/S scale of 2 to 3 after 1–2 mg midazolam administration, with no respiratory complications. Continuous capnography monitoring could make it possible to identify potential respiratory complications such as apnea.

Several studies reported that it takes longer to reach the target level of sedation with dexmedetomidine compared with propofol [5,9]. However, dexmedetomidine is a more

Table 1. Demographic Data

Case no.	Sex	Age (yr)	Weight (kg)	Height (cm)	BMI (kg/m ²)	Mallampati score	ASA classification
Case 1	Female	59	66	153	28.2	Grade 2	ASA 2
Case 2	Female	54	47	163	17.7	Grade 2	ASA 1
Case 3	Female	41	59	165	21.7	Grade 1	ASA 1
Case 4	Female	52	59	158	23.6	Grade 1	ASA 2

ASA: American Society of Anesthesiologists, BMI: body mass index.

Table 2. Case Summary

Case no.	Dexmedetomidine		Postural preparation time (min)	MOAA/S scale	Additional midazolam for induction (mg)	MOAA/S	MRI examination time (min)	Total anesthesia time (min)	PACU stay time (min)
	Loading dose (µg/kg)	Infusion dose (µg/kg/h)							
Case 1	1	0.6	13	5	1	3	40	55	55
Case 2	1	0.6	5	5	2	2	45	55	70
Case 3	1	0.6	13	4	1 + 1	2	47	60	32
Case 4	1	0.6	10	5	2	3	50	65	20

MOAA/S: modified observer's assessment of alertness/sedation, MRI: magnetic resonance image, PACU: post-anesthesia care unit.

appropriate drug than propofol for breast MRI, as it enables the patient's cooperation in assuming the prone position, which is essential to allow the breast to fit into the coil recesses. Considering that the onset of sedation of dexmedetomidine was 10.71 min, reported by Loh et al. study [5], it takes shorter time for completing the position than the onset of sedation of dexmedetomidine in our cases. In patients with claustrophobia, a slow induction of sedation may be a drawback. These patients may find it difficult to place their faces on the head rest. If the posture is completed faster than expected, midazolam can be administered to induce a rapid onset of sedation, as a rescue drug [6]. Bang et al. [13] reported that administering 0.025 mg/kg midazolam with 0.5 µg/kg of dexmedetomidine was superior than 1 µg/kg of dexmedetomidine only. Bol et al. [14] found that the use of dexmedetomidine and midazolam together caused a synergistic sedation effect with minor respiratory side effects in an animal study.

Dexmedetomidine is a highly selective alpha-2 receptor agonist with sedative, anxiolytic, and sympatholytic effects. Rapid administration of a loading dose of dexmedetomidine alone may cause bradycardia and hypotension due to sympatholytic effect [6,15], whereas cardiovascular side effects are reduced when using midazolam and dexmedetomidine together [13,14]. Because the loading dose of dexmedetomidine was administered over 10 min by a syringe pump, no bradycardia or hypotension events occurred during MRI examination in our cases. However, the asymptomatic hypotension in PACU in case 2 seemed to be caused by vasodilation at vascular endothelial cell, increased vagal activity, and inhibition of sympathetic release with a low plasma level of dexmedetomidine [4]. Therefore, routine monitoring of blood pressure is needed after cessation of dexmedetomidine administration. If necessary, administration of a vasoconstrictor or sympathomimetics should also be considered.

There are several limitations in our case report. First, because MRI limits access to the patient, we were not able to assess the patient's level of sedation during the MRI examination. We could only evaluate the patient's status according to movement, vital signs, and capnography from outside of the MRI room (Fig. 2). Second, claustrophobia was assessed only according to subjective self-reported anxiety and fear, rather than using objective diagnostic criteria for claustrophobia. As the mental and psychological states of the patient may have some effect on the success of sedation and the drug doses, it is necessary to evaluate the patient using objective diagnostic criteria. Finally, evaluating the level

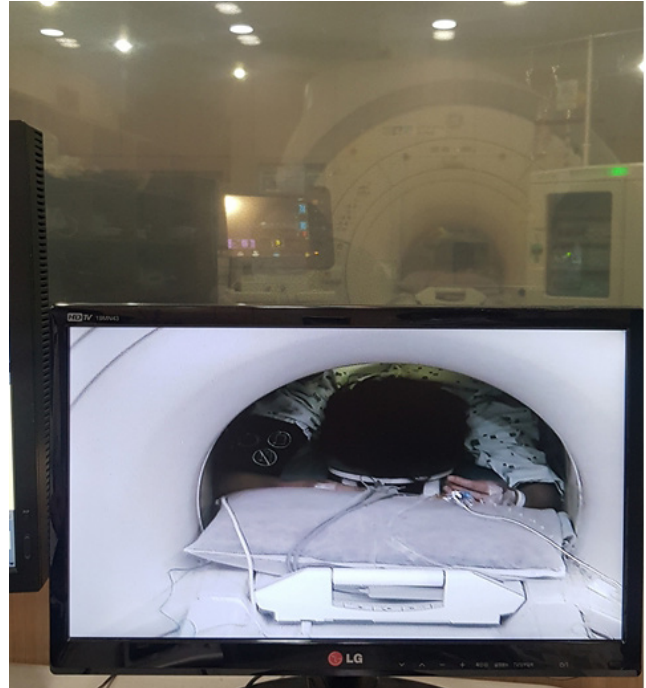


Fig. 2. Monitoring of patient and vital signs from outside the MRI room. MRI: magnetic resonance imaging.

of sedation is somewhat subjective, so it was difficult to quantify the amount of rescue midazolam because that was left to the discretion of the anesthesiologists.

In conclusion, with careful assessment of the patient's level of sedation, administration of the appropriate dose of dexmedetomidine, which has minimal effect on respiration, and timing of rescue midazolam for rapid induction will render MRI examination in the prone position safe and satisfactory, without respiratory complications. We administered dexmedetomidine at a loading dose of 1 µg/kg over 10 min, followed by a continuous dose of 0.6 µg/kg/h to sedate patients with claustrophobia in the prone position. In order to overcome a slow induction of sedation, 1–2 mg midazolam was administered, which resulted that all exams were conducted successfully without respiratory complications.

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CONFLICTS OF INTEREST

Yang-Hoon Chung has been an editor of the *Anesthesia and Pain Medicine* since 2018: However, he was not involved in the peer reviewer selection, evaluation, or decision process of this article. No other potential conflicts of interest relevant to this article were reported.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTIONS

Conceptualization: Jaewoong Jung, Yang-Hoon Chung. Data curation: Jaewoong Jung, Youjin Kang. Methodology: Jaewoong Jung, Yang-Hoon Chung. Visualization: Won Seok Chae. Writing - original draft: Jaewoong Jung, Yang-Hoon Chung. Writing - review & editing: Jaewoong Jung, Youjin Kang, Won Seok Chae, Yang-Hoon Chung. Investigation: Jaewoong Jung, Won Seok Chae, Yang-Hoon Chung. Supervision: Won Seok Chae.

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