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Case Report

Dexmedetomidine for Repeated Sedation in Pediatric Sedation During Consecutive Radiation Therapy

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External beam radiotherapy (EBRT) causes anxiety and claustrophobia in pediatric patients. To provide exact figures and radiation amounts, an appropriate sedation or anesthesia can be supplied. Alpha 2 agonist dexmedetomidine has been used for sedation and anesthesia in pediatric imaging. Dexmedetomidine has an advantage because it has minimal respiratory depression and no direct effects on myocardial function. We report repeated sedation with dexmedetomidine for 33 consecutive radiation therapies in 5 years old children.

Key Words: Dexmedetomidine; Radiotherapy; Sedation

The external beam radiotherapy (EBRT) has proven as an effective therapy for improving survival duration and the quality of life in the cancer treatment as a multidirectional approach. Adult patients can be treated with EBRT without sedation or anesthesia. But there were challenges for positioning and immobilization in children [1-3]. Anesthesia for EBRT in pediatric patients should provide immobilization during radiation therapy and immediate recovery after therapy. The wide varieties of anesthetics and regimen have been used to provide safe and effective EBRT in pediatric patients [2]. In case of EBRT, anesthesiologists monitor their patients' hemodynamic and respiratory status from a remote location. Respiratory depression was the most important matter to be attended to anesthesiologists during remote anesthesia.

Dexmedetomidine is a selective α_2-adrenoreceptor agonist that decreases sympathetic tone and attenuate the stress response to anesthesia and surgery. It was introduced during the 1990s as a sedative in the intensive care unit. Dexmedetomidine has no effect of myocardial function and minimal effect on respiratory function [4,5], these characteristics make an appealing agent for the ERBT in pediatric patients.

We present a case about using of dexmedetomidine as the sole sedation anesthetics for 33 consecutive EBRT sessions in a 5 year old child.

CASE REPORT

A 5 year old female child (111 cm, 21.4 kg) was admitted to hospital with nausea, vomiting and headache that had lasted for 4 weeks. Magnetic resonance imaging (MRI) revealed a contrast enhanced 3.7 × 4.3 cm lesion in left parietal lobe. A glioblastoma was suspected and confirmed histologically after craniotomy with tumor resection. After surgery, 33 consecutive radiation therapies (involved field, two co-axial isocentric field, fractionated; cumulative dose 61.2 Gy) were implemented for duration of 7 weeks. In order to plan proper radiation

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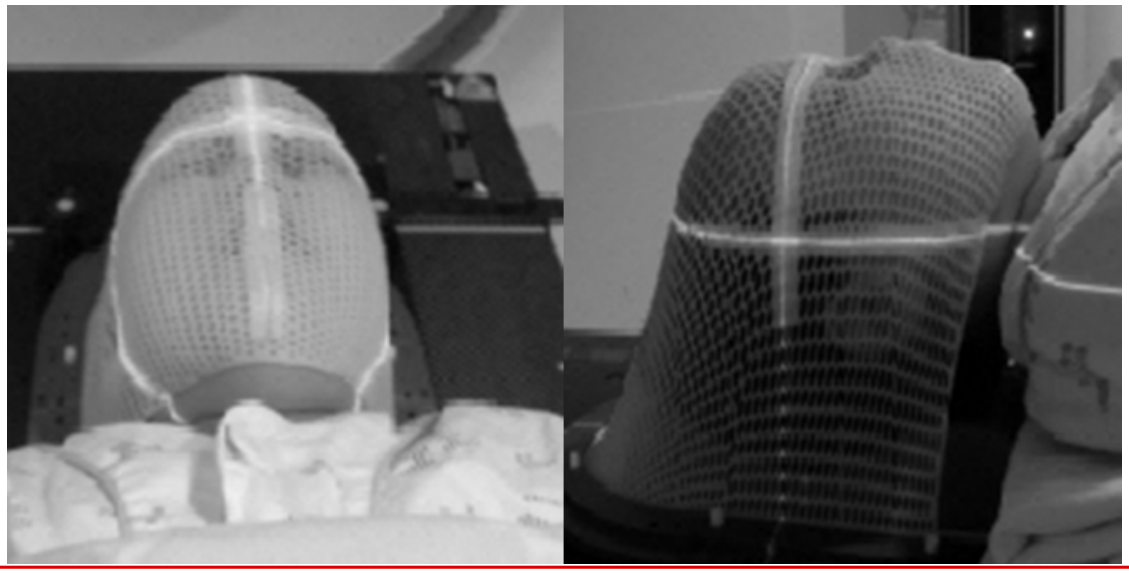

Fig. 1. The photograph shows a patient's plaster immobilization cast (Aquaplast RTTM, Q-Fix, Avondale PA).

doses and points of entry, she had undergone a simulation EBRT. Although she was sedated after dexmedetomidine (1 μg/kg) was administered over 10 min for sedation, she had moved while we pushed the plaster immobilization cast (Aquaplast RTTM, Q-Fix, Avondale PA) (Fig. 1) on her head. Therefore we used propofol (50 μg/kg/min) additionally after that the simulation EBRT had been completed.

After the simulation EBRT, repeated therapy was conducted to her once daily. Standard monitoring such as pulse oximetry, electrocardiography, and noninvasive blood pressure were applied to her and checked at an interval of 5 min during the procedure. Dexmedetomidine was infused as a loading dose of 1 μg/kg over 10 min and after then we stopped the administration of the drug. We assessed the level of sedation during dexmedetomidine infusion period and checked the time that sedation score was exceeded the 5 points. The level of sedation was checked using Ramsay sedation scale (Table 1). After that time, we laid her on the table at supine position and applied the plaster immobilization casts of the head, which made sure that she did not move during the radiation period, and the radiation was targeted to the lesion and the EBRT was started. While she received the EBRT, remote monitoring technique was used to facilitate monitoring from a long distance. We could observe her by two television cameras; each camera was modulated by switches near the screen, permitting control of zoom and focus of camera directing to the linear accelerator gantry and monitor.

Table 1. Ramsay Sedation Scale

Score	Observation
1	Nervous, agitated, and/or restless
2	Cooperative, orientated, quite patient
3	Only obeying the orders
4	Sleeping, suddenly responding to hitting the glabella, and high voice
5	Sleeping, slowly responding to hitting the glabella, and high voice
6	No response to any of these stimulations

The radiation period was 5 to 10 min on average. When we administrated loading dose at 1 μg/kg, 5 points of Ramsay sedation scale was acquired after drug administration 7.96 ± 1.03 min. The infusion of dexmedetomidine loading dose was used as a single sedation agent in 29 of the 33 procedures. We supplemented propofol 10 mg to her once in other 4 procedures because of adequate sedation state was failed. In two

procedures, she did not sedated because she felt the urge to urinate and in the other two procedures, she experienced numbness at intravenous assess site.

During the EBRT session, there were no adverse effects such as bradycardia (Heart rate (HR) < 70 beats/min), hypotension (Systolic blood pressure (SP) < 80 mmHg) and respiratory depression. The HR and mean blood pressure (MP) were decreased obviously comparison with before sedation (Fig. 2 and 3). The rescue regimens were prepared to treat the side effects; atropine 0.01 mg/kg for bradycardia, ephedrine 0.1 mg/kg for hypotension. Nevertheless, the changes of HR and MP were in normal range and did not need to be corrected. There was no change in peripheral oxygen saturation compared to before the sedation.

After each procedure, she went back to the patient's room as a sleep state. She recovered from the sedation at 90-100 min later since the stop to infusion of dexmedetomidine. After the EBRT, she revealed an alert mentality and no remarkable neurologic deficit.

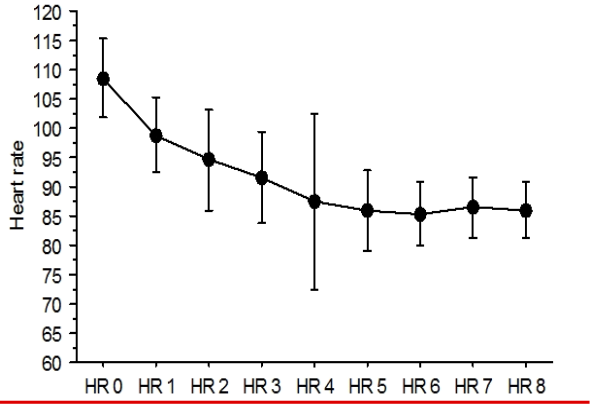

Fig. 2. A change of heart rate (HR) from baseline to every 5 min after dexmedetomidine infusion. HR 0 means the time of infusion starting of dexmedetomidine. Hereafter, HR 1 to HR 8 was named the time at interval of 5 min. HR; heart rate.

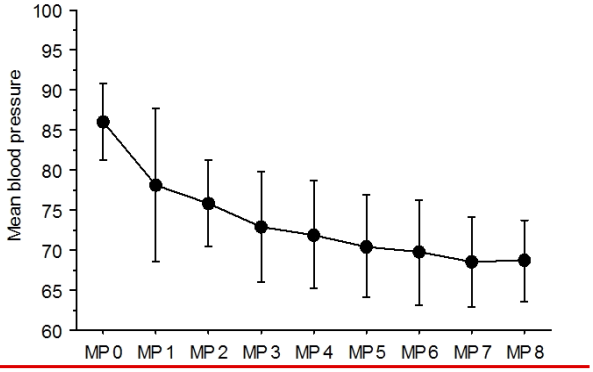

Fig. 3. A change of mean blood pressure from baseline to every 5 min after dexmedetomidine infusion, MP 0 means the time of infusion starting of dexmedetomidine. Hereafter, MP 1 to MP 8 was named the time at interval of 5 min. MP; mean blood pressure.

DISCUSSION

In our experience, we could use the dexmedetomidine for repeated 29 of the 33 consecutive EBRT procedures as a single sedation anesthetic except in the 4 cases using propofol due to inappropriate sedation.

The goals of sedation for pediatric radiotherapy include a short duration of action, not painful administration, a prompt recovery and minimal respiratory depression. Ketamine is a short acting dissociative anesthetic which has amnesia and analgesic property in a short time. It does not produce a significant respiratory depression. However, the drug generates unpleasant emergence reactions such as hallucination, out-of-body experience. In this respect, using of ketamine is limited as a sedative in pediatric patient [6]. Propofol can produce rapid induction of sedation and recovery. Although, there is a limitation on use of propofol in remote anesthesia because it increases the risk of respiratory depression. Dexmedetomidine has been shown to have sedative properties without respiratory depression it seemed to us that dexmedetomidine had many characteristics of ideal sedative for remote anesthesia in pediatric radiotherapy [7].

Heard et al. [8] stated that the use of dexmedetomidine for pediatric MRI sedation by itself is unable to reliably produce the required light general anesthesia owing to the movement of patients. Also, Rajashekhar et al. [9]

reported that high does dexmedetomidine can be successfully used for pediatric MRI sedation, but a significant number of children require additional medications for optimal control. In those studies, the sedation time for pediatric MRI had been over 30 min, for that reason the potential of movement during the procedure would be increased and additional sedative might be demanded. In our cases, we expected that the infusion of loading dose dexmedetomidine would be sufficient for her sedation because the entire process of radiation could be completed from 5-10 min. During the EBRT period, the infusion of loading dose dexmedetomidine (1 μg/kg) induced adequate sedation state in 29 of the 33 procedures and propofol was used additionally in an improper sedation conditions. In the 4 procedures of insufficient induction of sedation, the causes of the failure were her agitation from pee and feeling of numbness from intravenous assess site. The numbness could be caused by recurrence of tumor or abnormal lesion in brain, but there was no specific finding in the Computerized Tomography (CT).

The complications of dexmedetomidine such as bradycardia, hypotension did not occurred significantly. In the report of Rajashekhar, there were spontaneous resolutions of bradycardia, hypotension without intervention in the case of using of high dose dexmedetomidine infusion.

The development of tolerance during administration and withdrawal on discontinuation of dexmedetomidine has not been well studied in adult or pediatric patient. There are retrospective studies have researched about effect of long term infusion of dexmedetomidine. In that research, the maximal infusion time was 50 days. The incidence of tolerance and withdrawal effect does not increase with prolonged infusion duration [10,11]. A retrospective single-center cohort study evaluated 75 mechanically ventilated adults who received dexmedetomidine infusion, 21% of dexmedetomidine infusion episodes met the criteria for intolerance. And there are no predictors of intolerance were found to be clinically significant [12]. In this case, dexmedetomidine had been used for 33 times of consecutive EBRT and there were not a tolerance and the other complications.

Mason et al. [13] showed that recovery time from dexmedetomidine sedation was 24.8-35.2 min during MRI scans using loading dose of 2 to 3 μg/kg and the infusion rate increased from 1 to 1.5 to 2 μg/kg/h. In that study, discharge criteria required a minimum Aldrete score of 9 points and in our cases, she presented not fewer than Aldre score of 9 points immediately after radiation therapy. Heard et al. [8] reported that a discharge time after MRI scan was approximately 90 min using the bolus dose 0.5-1.5 μg/kg and infusion rate 1-1.5 μg/kg/h for dexmedetomidine. The mean time to awake completely after the interruption of dexmedetomidine infusion was 90-100 min in our study. On account of the limited space of radiation therapy room in our hospital, it was difficult to observe her after the EBRT. Therefore, we transferred her to the ward after observation for 30 min when she responded to verbal order and her guardian recorded a mean time to awake.

The previous studies and this case suggest that single infusion of dexmedetomidine for procedural sedation is limited in such a case of the procedures being taken longer than 30 min, however it can produce a sufficient sedation state and no movement in the short procedures being taken within 10 min.

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