

# The Success of MRI without Sedations in 6-15 Years Old Pediatric Patients after Watching MRI Introductory Video

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High-quality imaging is important for effective diagnosis and treatment in pediatrics. In order to obtain such high-quality image, the patient has to be still during the scan, which may or may not require sedation depending on each patient's condition. This study, conducted at Siriraj Hospital in Bangkok, Thailand, focused on patient factors that influence success of radiologic procedures for patients without sedation. The participants were children aged between 6 to 15 years old. Participants and parents were asked to watch a 5-minute MRI introductory video, which was specially designed for children. Participants would then make decision whether they needed sedation or not. Fifty-five patients were included in this study. There were 37 patients agreed with non-sedation technique. Ninety-four percent of children (35/37) who decided to proceed without sedation, were able to complete their MRI sessions. Factors identified from this study that determined success in MRI without sedation in 6-15 years old patients were children at aged 11-15 years and children who had previous exposure to MRI without need of sedation/anesthesia. There was no anesthetic complication in sedation group.

**Keywords:** MRI, Pediatric, Non-sedation

**J Med Assoc Thai 2016; 99 (5): 596-601**

**Full text. e-Journal:** <http://www.jmatonline.com>

High-quality imaging is increasingly in demand to aid diagnosis and treatment options and to monitor treatment response. To obtain high-quality imaging in pediatric patients is challenging. Sedation is often required in order to prevent patient movement during the process, which may result in poor-quality image.

There are many reports on the adverse effects of sedation in radiology suites<sup>(1-4)</sup>. Common risks include respiratory depression, loss of protective reflexes and inability to maintain airway and may eventually lead to cardiac arrest.

Approximately 100 pediatric MRI scans performed annually at Siriraj Hospital. Fifty percent of 6-15 years old cases completed the scan without sedation. Anesthesia service provided at MRI suite was 2 days/week. However, children below 12 years of age are usually scheduled on those days because of

uncertainty of patient cooperation. This may prolong the waiting time for a scan up to 6 months.

From literature review, little was mentioned on specific patient characteristics related to successful MRI scan without sedation. Vannest et al reported higher success rate in children aged 7 years and older than the younger group, but could not identify other factors<sup>(5)</sup>.

The authors conducted this study in 6-15 years old patients and would like to identify any risk factors that relate to successful MRI session without sedation.

## Material and Method

The study was reviewed and approved by Siriraj IRB. Written informed consent was obtained from the parents along with assent from the patient.

## Study design

This single-center prospective interventional study was performed in Siriraj Hospital, Bangkok, Thailand from July 2014 to July 2015.

## Objectives

The objectives of the study were: 1) to identify

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the success rate of MRI in 6-15 years old, non-sedative pediatric patients after watching MRI introductory video, 2) to identify factors determining success in MRI without sedations in 6-15 years old pediatric patients, and 3) to identify complications of sedation/anesthesia for MRI in children.

### Participants

Six to 15 years old, pediatric patients who were scheduled for elective MRI procedures in July 2014-July 2015. Patients with neurovascular diseases contributing to resting tremor or any abnormal/uncontrolled movement were excluded.

### Methods

Before the MRI procedure, the patient and the parents were requested to answer the questionnaire about the patient's demographic information and previous exposure to radiologic study and anesthesia. Then they would watch a 5-minute introductory video. The story was presented as both cartoon animation and real MRI set up, narrating in a kids-friendly tone and age-appropriated context. The contents included scanner suite introduction, how the scanner works, patient's position in scanner and audio of the scanner. Patients would then make decision whether they needed any sedation for the scan session.

Non-sedated children were allowed to stay in the MRI scan on their own or with parent present, with no monitor attached to the patient and no intravenous line placed (in case of non-contrast study). They could communicate with the MRI technicians and anesthesiologists at all times through a speaker. Disposable earplugs or earmuffs would also be provided for children and parents for noise reduction. Exaggerate patient's movement recognized by the technician would be informed to the patient and be recorded. Patient's complaint would be responded right away. In case of patient exhausted, they would be encouraged to finish their goal by all staffs. However, if the patient stated that they could not be still any longer, the anesthesiologist would go into the scan room to give sedation and continue scanning process. After the procedure, a complimentary gift would be provided to all children as their commitments were accomplished.

For those who decided to take the sedative option, they would be given sedatives per attending anesthesiologist's decision.

### Data collection

The record form consisted of: 1) Patient

demographic (age, gender, ASA physical status, comorbidity, mental status, history of radiologic procedures, history of anesthesia, using of contrast media in the study, procedure time and part of MRI), 2) Radiologic information (study area, duration of study and quality of MR imaging), and 3) Anesthetic data (anesthetic technique, duration of anesthesia, anesthetic agent used and complications).

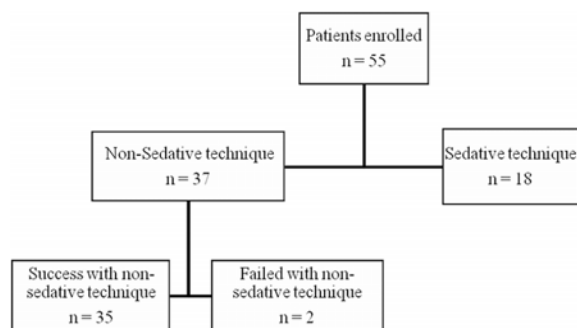
### Statistical analysis

Data was conducted during July 2014 to July 2015. Two non-sedation failure patients were included in a 'non-sedation' group. Data analysis was performed using SPSS for windows version 18. Quantitative variables were demonstrated as mean  $\pm$  standard deviation (SD) or median (range) if were not normally distributed. Qualitative variables were reported as frequencies and percentage. Comparison between 2 groups (sedation and non-sedation) was analyzed by using unpaired t-test, or Mann-Whitney U test (if it were not normally distributed) for quantitative variables and analyzed by using Chi-squared test or Fisher's exact test for qualitative variables, *p*-value less than 0.05 was considered statistically significant.

### Results

Fifty-five participants were enrolled in this study. After watching the introductory video, 37 participants (67.2%) decided to proceed with non-sedative option. Ninety-four percent of non-sedated group (35 participants) went through MRI scan course successfully while two cases were unable to complete the scan and requested sedation afterwards (Fig. 1).

Patient characteristics of sedation and non-sedation groups were compared in Table 1. The only



**Fig. 1** Number of total participants, non-sedative technique participants and sedative technique participants.

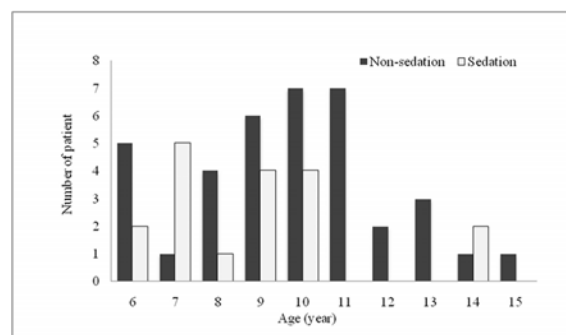
factor that related the success of MRI scan without sedation identified in this presented study was previous MRI experience without sedation. Patient's socioeconomic level, such as parents' incomes, parents' education levels were not different between two groups. Patient's order of siblings in the family and primary guardian (father/mother/grandmother/nanny) were not different. The scanned body part and scan duration had no significant difference between two groups. The longest duration in non-sedation group was 270 minutes. The authors also found similar result when apply two non-sedation failure cases as 'sedation' group.

Patients of an older age (11-15 year) were likely to succeed without sedation compared with younger age (6-10 year). Distribution of participants of each age who completed MRI scans with non-sedative and sedative techniques are presented in Fig. 2.

All MR images in both sedation and non-sedation groups were reported to have 'good' quality. Children who required sedation mostly received intravenous propofol infusion combined with ketamine and midazolam. There were no sedations reported in our study.

There were two patients who initially decided

to proceed with non-sedation technique, but could not complete the scan and requested sedation afterwards. The first one was a 10-year-old girl with a diagnosis of seizure. She previously had a successful MRI head scan without sedation 1 year ago. This time after started scanning for 30 min, she cried and said 'It was too loud', then refused to continue the procedure without sedation. She denied putting on earplugs since the beginning of scan process. The image quality was also



**Fig. 2** Distribution of participants of each age who completed MRI scans with non-sedative and sedative techniques.

**Table 1.** Demographic data in non-sedation and sedation groups

Factor	Non-sedation group (n = 37)	Sedation group (n = 18)	p-value
Mean age (years)	9.8±2.3	8.8±2.3	0.159
Age group (years)			0.041*
6-10 years	23 (62.1%)	16 (88.9%)	
11-15 years	14 (37.9%)	2 (11.1%)	
Male	15 (40.5%)	11 (61.1%)	0.152
Comorbid condition	6 (16.2%)	0	0.162
Abnormal mental status	0	1 (5.6%)	0.327
Delayed development	1 (2.7%)	1 (5.6%)	1.000
Previous CT/MRI	25 (67.6%)	13 (72.2%)	1.000
MRI exposure(s) before this visit	1 (0,8)**	1 (0,6)**	0.219
Prior MRI succeed without sedation (at least 1 session)	17 (45.9%)	4 (22.2%)	0.003*
Examination part			0.099
Brain	24 (64.9%)	10 (55.6%)	
Head & neck	1 (2.7%)	2 (11.1%)	
Extremity	1 (2.7%)	2 (11.1%)	
Spine	11 (29.7%)	4 (22.2%)	
Procedure time (minute)	60 (35-270)**	65 (40-165)**	0.672

\* = p-value <0.05; statistically significant

\*\* = number in this data set presented as median (min, max)

poor. The second one was a 6-year-old boy who had a first episode of MRI scans at lumbosacral plexus and sciatic nerve. He was able to stay still until at 60 minutes of the scan, he cried and said 'It was too long for a scan', then sedation was given.

## Discussion

Attempt MRI scan without sedation in pediatric patient involved in many techniques that contribute to decrease patient movement in a loud, uncomfortable environment. The choice of approach to pediatric MRI is multi-factorial, with limited scientific evidence for many of the current approaches. These considerations may enable others to image children using MRI under different circumstances<sup>(6)</sup>. However, particular technique should be selected to match each child's specific needs or concerns. For examples, infants can be swaddled and give sucrose and/or pacifier in conjunction during the scan. Sleep manipulation with deprivation technique can be used in infants and children less than 2 years of age. However, scanning at the usual sleep time was reported a high success rate in infant and small children<sup>(7)</sup>, as well as, prescribing melatonin for children before sedation<sup>(6)</sup>. In children, hypnosis and guided imaginary played role in MRI with variable results. Children's hospital and some hospitals for both adults and children have decorated their MRI suites in a more eye-catching theme for children, and also provide MRI compatible audio-visual system<sup>(8,9)</sup>, such as MRI compatible video goggles<sup>(10)</sup>, virtual reality<sup>(11)</sup> or image/cartoon from Snoezelen projectors that placed outside the scan room<sup>(6,10)</sup>, to entertain or distract children along scanning process. Parental present during MRI scan helped increase success rate in case of well compliance parents with interval reports and communications with the staff member outside the scan room<sup>(6)</sup>. Intervention such as mock MRI practicing before scheduled day was also reported increasing in non-sedating rate in anxious older children<sup>(6,12,13)</sup>, even in special case, such as autistic children<sup>(14)</sup>. Play therapy with played specialists or psychologists helped avoiding sedation in anxious older children or those with behavioral difficulties<sup>(6)</sup>. A study in 4-10 years old children reported 50% reduction of sedation rate for MRI procedure with play therapy<sup>(15)</sup>. However, in older children with cerebral palsy, developmental delay, or uncontrolled movements usually require sedation or anesthesia<sup>(3)</sup>.

This study showed that children at older age (11-15 years) were likely to success without sedation. Children's age group was older than previous study

by Vannest et al (7 years and older)<sup>(5)</sup>. However, this study had no other distraction or entertaining equipment provided for children during MRI scan which may provide benefit for children younger than 11 years old. Children who had previous MRI scan(s) without sedation, was also a factor that associated with successful non-sedated MRI scan. Theoretically, patients with developmentally delayed should have higher chance of non-cooperation. However, the number of participants in this study may not have enough power to detect this factor.

Before this study, the radiology nurses informed parents and patients regarding the detail of the study only by verbally explanation. Due to time limit and occupied scan room, patient and family rarely had opportunity to see the real set up or practice a mock MRI before the examination day. Leaving the decision as to whether that child would require sedation or not, happened in front of the MRI suite just before the scan started. Watching introductory video provides easy-to-understand information so that the children could authorize decision by themselves. In addition, that may lead to the success of non-sedation technique in the majority of the participants who agreed to proceed with this technique. Two children who considered as non-sedation failures were initially good candidates for the first 0.5 and 1 hour respectively. They were probably able to stay in the MRI suite in a more comfortable and entertained environment long enough to complete the scan session. The period of MRI scan in this study varied from 30-270 minutes, which was considered longer than other reports<sup>(6-8,13,15)</sup> (mostly 1 hour). This may be another important factor led to failure of non-sedation technique in present study.

The MRI introductory video was considered as tool for MRI process preparing in children between 6-15 years old. However, the result in each particular age varied (Fig. 2). Overall, watching MRI introductory video in this study was able to reduce the need for sedation in 6-15 year-old children during MRI procedure in our institution approximately 13.6% (as compared with 50% in our unpublished data done in 2014). Comparing with other techniques, watching MRI introductory video provide greater effect than mock MRI<sup>(11)</sup> (8.8% reduction of sedation/general anesthesia in 3-14 years old patients) and equivalent effect with play therapy<sup>(15)</sup>.

## Limitation

The limitation of this study was a single center study. Although Siriraj Hospital has patients from all

regions of Thailand, we use only common Thai language in the video. Children or parents who usually acquainted to their local dialect may not completely understand video content or verbal explanation thoroughly enough to make decision. This study also has limited numbers of participants due to renovation of MRI site in the period of data collection.

#### **Future study**

A practice of watching MRI introductory video is subsequently cooperated in a regular workflow at Siriraj Hospital. The authors will continue collecting more data and may be able to identify more factors that influence pediatric patient's decision of having MRI scan without sedation in the future. Patient satisfaction of this technique is also another important component that should be evaluated because some of these children had scheduled interval MRI scans for disease follow-up. Voice of children in non-sedation failure group is also another interesting area to investigate in order to improve quality of care in the future. Introducing this video in patients younger than 6 years old who can understand video content and look for any possibility of any reducing in need for sedation. MRI introductory video narrated in variety of major dialects that may make children and their caregiver more understand its content is another possibility of study. Combination of watching MRI introductory video and other techniques to facilitate patient cooperation such as audiovisual system, hypnosis, and even simple decoration of a scan room in a more attractive fashion, can be further investigated.

#### **Conclusion**

In our study, patient characteristics factors determining success in MRI without sedation after watching 5 minutes MRI introductory video were children aged 11-15 years old and children who had previous MRI scan without need of sedation/anesthesia. Overall success rate of non-sedation MRI in 6-15 years old patients was 63.6%. There was no complication observed in sedation group. Introductory video can be further investigated as aiding tool to prepare children prior to MRI sessions.

#### **What is already known on this topic?**

MRI procedures in school-age children can be achieved without sedation. Preparing children with mock MRI and environmental modification of a scan room in a kids-friendly fashion are key factors.

#### **What this study adds?**

MRI scans in 6-15 years old pediatric children without need for sedation is possible in a limited resource and regular room set up at general hospital. School-age children who experienced with MRI study without sedation are more likely to be able to repeat it again, especially in children aged 11-15 years old. There were no other specific patient characteristics related to successful MRI without the sedation presented in the study. MRI introductory video may be an interesting tool to school-age children before MRI sessions.

#### **Acknowledgements**

Authors would like to thank Dr. Saowalak Hunnangkul for contributing on statistical analysis and Miss Nichapat Suksri for contributing on organizing this present study.

#### **Potential conflicts of interest**

None.

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ความสำเร็จในการตรวจเอกซเรย์ภาพสะท้อนในสนามคลื่นแม่เหล็ก (MRI) โดยไม่ต้องได้รับยาสลบในผู้ป่วยเด็กอายุ 6-15 ปี ภายหลังจากคู่มือที่คัดสรรแนะนำการตรวจ

พิชชา ไทยะวิญญู, ปกัสสร หวานขัน

ในการตรวจภาพสะท้อนคลื่นแม่เหล็ก (MRI) ผู้ป่วยต้องอยู่นิ่งเพื่อให้ได้ภาพคมชัดเพื่อใช้ประกอบการวินิจฉัยหรือให้การรักษาในผู้ป่วยเด็ก จึงอาจจำเป็นต้องได้รับยาทำให้สงบในกรณีที่ไม่สามารถอยู่นิ่งได้เองโดยวิธีการต่างๆ คณะผู้นิพนธ์จึงทำการศึกษาในกลุ่มผู้ป่วยเด็กอายุ 6-15 ปี ซึ่งเป็นกลุ่มที่มีโอกาสตรวจได้สำเร็จโดยไม่ต้องได้รับยาทำให้สงบ โดยเก็บข้อมูลที่โรงพยาบาลศิริราชเพื่อหาปัจจัยด้านผู้ป่วยที่ส่งผลให้การตรวจ MRI สำเร็จ โดยไม่ต้องให้ยาทำให้สงบ โดยให้ผู้ป่วยคู่มือที่คัดสรรแนะนำการตรวจความยาวห้าหน้าที่จัดทำในรูปแบบการ์ตูน ร่วมกับภาพที่ถ่ายทำจากสถานที่จริงในวันนัดตรวจและให้ผู้ป่วยตัดสินใจเลือกว่าสามารถนอนนิ่งได้เองหรือต้องการตรวจโดยให้ยาทำให้สงบ ผลการศึกษาในผู้ป่วยรวม 55 ราย มีผู้ป่วยที่ตัดสินใจว่าจะนอนนิ่งด้วยตนเองได้หลังจากคู่มือที่คัดสรรแนะนำการตรวจ 37 ราย และสามารถทำได้สำเร็จ 35/37 ราย (94.5%) ปัจจัยที่พบว่ามีความสัมพันธ์กับความสำเร็จในการตรวจโดยไม่ต้องให้ยาทำให้สงบคือ ผู้ป่วยเด็กโตกลุ่มอายุ 11-15 ปี และกลุ่มผู้ป่วยที่เคยตรวจ MRI โดยไม่ต้องได้รับยาสลบมาก่อน ส่วนกลุ่มที่ได้รับยาทำให้สงบนั้นไม่มีพบมีภาวะแทรกซ้อนใด

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