

# A Comparative Study of Classic Laryngeal Mask Airway and I-Gel in Spontaneously Breathing Anesthetized Children Undergoing Magnetic Resonance Imaging.

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## ABSTRACT

**Background:** Supraglottic airway devices (SADs) are routinely being used in Magnetic Resonance Imaging (MRI) suite but there is a lacuna in the literature regarding their in vivo comparison. The study was planned to compare two of the commonly used SADs, cLMA and i-gel in children undergoing MRI. **Methods:** A prospective randomized study conducted in a tertiary care teaching hospital. 50 ASA I or II children (aged 12 to 48 months) scheduled for MRI brain were included. Patients were randomly assigned to cLMA or i-gel group (25 patients in each group). We assessed a number of attempts, insertion time, oropharyngeal leak, MRI artifacts and post-procedure complications. **Results:** Time taken for insertion in i-gel group was significantly lower as compared to cLMA group ( $p=0.006$ ). Artefacts were observed in all the patients in cLMA group and none in i-gel group, which was extremely significant statistically. **Conclusion:** i-gel is superior to cLMA for MRI as it does not have any ferromagnetic constituent.

**Keywords:** Classic laryngeal mask airway, i-gel, magnetic resonance imaging, anesthesia, artefacts.

## INTRODUCTION

Magnetic resonance imaging (MRI) is a safe, radiation free diagnostic technique, which is increasingly being used in pediatric patients. However, the procedure is generally time consuming, requires the child to be away from the parents and to lie still in an uncomfortable environment due to loud noises and cold temperature. The above said challenges warrant the administration of sedation or general anesthesia, depending on individual preferences and institutional protocols. Supraglottic airway devices (SADs) are becoming popular for administration of general anesthesia in MRI suites.<sup>[1,2]</sup> Apart from their excellent usefulness, an important concern during MRI is their effect on image quality due to the presence of ferromagnetic constituents. Reports are available regarding the successful use of classic laryngeal mask airway (cLMA) and i-gel for MRI.<sup>[3,4,5]</sup> Also, two in- vitro studies have been done comparing the imaging quality with various SADs including cLMA and i-gel.<sup>[6,7]</sup> To the best of our knowledge no literature is available comparing the in- vivo use of cLMA and i-gel in MRI suite.

Hence, we conducted this study to compare the two devices in paediatric patients scheduled for MRI.

## MATERIALS AND METHODS

After getting approval from ethical committee, a randomized prospective study was conducted to compare cLMA and i-gel for the conduct of MRI in 50 paediatric patients. The patients included in the study belonged to American Society of Anesthesiologists class I or II, aged between 12 to 48 months, scheduled to undergo MRI brain under general anaesthesia. Patients with recent upper respiratory tract infection or anticipated difficult airway were excluded. All the patients were randomly allocated to one of the two groups: Group I (i-gel, n=25) and group C (cLMA, n=25). Prior written and informed consent was taken from the parents and a standard anaesthesia technique was used. A fasting period of six hours for solids and two hours for clear liquids was ensured. Patients were brought to zone II of MRI suite on MRI compatible trolley and were shifted to zone III (magnet room) after induction of anaesthesia. All standard monitors including electrocardiography (ECG), oxygen saturation (SpO<sub>2</sub>), non-invasive blood pressure (NIBP) and end tidal carbon dioxide concentration (EtCO<sub>2</sub>) were attached. Antisialagogue premedication (glycopyrrolate, 0.01mg kg<sup>-1</sup>) was given prior to induction. Inhalation induction using sevoflurane was done and loss of tone of outstretched arm and easy up and down movement of lower jaw was observed as endpoints. An experienced anaesthesiologist then

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inserted the allocated SAD (cLMA or i-gel). The size of the device and amount of air required to inflate the cuff (in cLMA) was chosen as per manufacturer’s recommendation. An appropriate sized suction catheter was passed through the gastric channel in case of i-gel. Proper placement was confirmed with good chest expansion, auscultation and capnography. The device was securely taped from maxilla to maxilla. Oropharyngeal leak was assessed by neck stethoscopy for any audible sounds. Patients were then shifted on to the MRI table and imaging was commenced after earplugs were applied. Anaesthesia was maintained with sevoflurane 1-2% and 50% nitrous oxide in oxygen with spontaneous ventilation. At the completion of procedure, sevoflurane and nitrous oxide were discontinued and SAD was removed once the patient was awake. During the study period following parameters were observed:

1. Vital parameters: Heart rate (HR), Mean Arterial Pressure (MAP) and SpO<sub>2</sub> were recorded at insertion and after insertion of SAD.
2. Number of attempts: A scale of one to four was used. 1,2,3 in first attempt, second attempt, third attempt, respectively and 4 for failure of SAD insertion and an alternate method to secure the airway was used.

3. Time taken for insertion: Time was measured from the moment the SAD was picked up in hand till adequacy of ventilation was confirmed by chest rise.
4. Oropharyngeal leak: It was assessed by placing stethoscope over the neck and was graded as present or absent audible sounds.
5. Image quality: presence or absence of artifacts was noted.
6. Complications: any complications such as blood on SAD, displacement during procedure and laryngospasm were noted.

Statistical analysis was done using SPSS software version 17.0 (SPSS Inc., Chicago, IL, USA). The quantitative data were analysed using Fisher’s exact test (two tailed) and the qualitative data were analysed using Chi-square test. A p value of < 0.05 was considered to be statistically significant.

## RESULTS

The demographic data and MRI duration were comparable in both the groups, with no statistically significant difference [Table 1a]. The vital parameters, namely MAP, HR and SpO<sub>2</sub> were comparable as well [Table 1b]. The number of attempts for insertion in the two groups was comparable and there was no failure of insertion [Table 2].

**Table 1:** Patient characteristics and vital parameters

	cLMA (n=25)	i-gel (n=25)	p- value
<b>a) Demographic profile</b>			
Age (months)	29.12 ± 10.49	28 ± 9.85	0.698
Weight (kilograms)	12.09 ± 1.90	12.12 ± 1.81	0.954
Gender (male: female)	14:11	15:10	1.00
MRI duration (minutes)	34.72 ± 7.17	34.32 ± 8.83	0.861
<b>b) Vital parameters</b>			
Mean arterial pressure			
Before insertion	72.89 ± 3.63	73.26 ± 2.98	0.695
After insertion	75.14 ± 3.10	75.92 ± 3.46	0.405
Heart rate			
Before insertion	104 ± 6.21	102 ± 5.17	0.221
After insertion	110 ± 5.84	107 ± 7.25	0.113
SpO <sub>2</sub> (%)	100	100	-

**Table 2:** Comparison in the two groups, cLMA and i-gel

	cLMA (n=25)	i-gel (n=25)	p- value
Insertion attempts (1/2/3)	21/3/1	23/2/0	0.662
Time for insertion (seconds)	17.8 ± 4.53	14.92 ± 2.33	0.006
Oropharyngeal leak (present/absent)	5/20	2/23	0.417
Artefacts	25	0	0.0001
Complications			
Blood on device	3	1	0.609
Displacement	0	0	-
Laryngospasm	0	0	-

The mean time of insertion (± standard deviation) was 17.8 ± 4.53 and 14.92 ± 2.33 seconds in cLMA and i-gel group respectively. The difference was

statistically significant with p = 0.006. Oropharyngeal leak was present in 8% patients in i-gel group and 20% in cLMA group, although this

was not statistically significant ( $p=0.417$ ). Artifacts were present in all the patients in cLMA group against none in i-gel group and the difference was extremely statistically significant ( $p = 0.0001$ ). [Table 2]

Blood on the device on removal was observed in three patients in cLMA group and one patient in i-gel group which was not statistically significant ( $p = 0.609$ ). There was no incidence of intraoperative displacement or laryngospasm. [Table 2]

## **DISCUSSION**

MRI suite presents a challenging environment for the anaesthesiologist and safety of children is of utmost concern due to the restricted access to the airway.<sup>[2]</sup> When general anaesthetic is planned for the MRI, supraglottic airway devices (SAD) seem to be better choice over an endotracheal tube. The reason being that with a SAD lighter plane of anaesthesia with spontaneous ventilation suffices meanwhile ensuring a secure airway and a motionless child. Moreover, it is also possible to avoid neuromuscular blocking drugs. The choice of SAD is broadly influenced by availability, MRI compatibility, individual preferences and institutional protocols. Both cLMA and i-gel have been reportedly used for the conduct of MRI but there are no comparative studies available.<sup>[3-5]</sup> Although two in vitro studies compared the effect of SADs on image quality<sup>[6,7]</sup> in vivo studies are lacking.

In our study, the insertion of i-gel was successful at first attempt in 23 of the 25 patients which was comparable to 21 of 25 in cLMA group. In the remaining patients, i-gel could be inserted successfully in second attempt while in cLMA group; one patient required a third attempt. Our study differed marginally with respect to number of attempts from another study by Das et al.<sup>[8]</sup> This may be because in this study cLMA and i-gel were compared in anaesthetized and paralysed children whereas in our study, all the patients were spontaneously breathing under sevoflurane in oxygen.

We noted that the time taken for insertion of i-gel was significantly less than that for cLMA. Similar results were observed by Helmy et al., and Polat et al., who had compared the two devices in adult patients.<sup>[9,10]</sup> I-gel is a second generation SAD, which offers unique advantages in terms of it being anatomically designed, made up of gel like thermoplastic elastomer with a pre shaped non inflatable cuff.<sup>[11]</sup> All these characteristics make it a highly useful device which is easily and rapidly inserted and requires minimal maneuvering. Absence of cuff and hence no need for cuff inflation may be one the reasons that i-gel requires less time for insertion than cLMA.

Oropharyngeal leak was present in two patients in i-gel group was comparable to cLMA group (5 out of 25). Although the oropharyngeal leak was present in a number of patients in cLMA group, in practice it was acceptable in terms of adequacy of ventilation. The major limitation of use of cLMA in prolonged procedures is gastric distension due to oropharyngeal leak (or low seal pressure). On the contrary, i-gel has an inbuilt gastric channel to decompress stomach by inserting and leaving a gastric tube in situ.

In majority of available studies, oropharyngeal leak pressure was significantly higher with i-gel than cLMA.<sup>[8,12,13]</sup> A notable limitation of our study was inability to objectively measure oropharyngeal leak pressure due unavailability of MRI compatible equipment to measure the same. Hence, we had used a Jackson-Rees circuit to conduct the anaesthesia and graded the oropharyngeal leak as 'present' or 'absent' audible sounds with neck stethoscopy.

In the context of image quality, no artifacts were seen with i-gel and image quality was excellent. In the cLMA group, although the artifacts were seen in all the patients, the image quality was described as satisfactory by the radiologist and did not have any clinical implications in MRI interpretation. This may be because the radiologists in our institute are accustomed to such artifacts due to the predominant use of cLMA before i-gel was inducted into anaesthetic practice in MRI suite. This also implies the importance of communication between anaesthesiologist radiologist regarding the devices being used to avoid misdiagnosis.<sup>[14]</sup>

cLMA is made up of silicone which resembles human tissues under imaging and contains metallic spring in the pilot balloon, hence interfering with the image quality.<sup>[15]</sup> I-gel on the other hand is metal free, silicone free and made up of medical grade thermoplastic elastomer, giving a superior image quality. Our findings in terms of image quality were consistent with results of an in vitro study by Zaballos et al. They inferred that i-gel supraglottic airway may be more appropriate for use during MRI.<sup>[5]</sup>

The incidence of complications (namely displacement and laryngospasm) was very low in all the patients of the two groups. Blood on the device on removal was seen in three patients in the cLMA group as compared to one patient in i-gel group. This was not found to be statistically significant nor had any clinical implications.

Although we compared two commonly used SADs, lack of comparison with another likely competitor Ambu disposable LMA, remains a limitation of this study.

From our study, we conclude that since i-gel does not contain any ferromagnetic material, it is superior to cLMA for conduct of MRI in children in terms of providing excellent image quality. As

cited earlier, more in vivo studies are warranted to compare various other SADs to search for the most appropriate airway device for use in MRI suite.

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