

# Original articles

## Extraglottic airway devices for use in diving medicine – part 3: the i-gel™

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### Key words

Extraglottic airway devices, airway control, diving bell, deck decompression chamber

### Abstract

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Resuscitation or airway control of an unconscious diver in a diving bell (DB) or deck decompression chamber (DDC) is difficult. Although the laryngeal mask airway (cLMA) has been recommended by the Diving Medical Advisory Committee, it is associated with many problems in a DB or DDC because of its cuff. A new cuffless airway device, the Intersurgical i-gel™, has been released. This small study showed that diver medical technicians (DMTs) preferred the i-gel to the cLMA because it lacked a cuff and was easier to insert from any position. The i-gel is therefore recommended for use in resuscitation in a DB or DDC.

### Introduction

A review of airway management in a diving bell (DB) or deck decompression chamber (DDC) was recently published.<sup>1</sup> However, since then, a new cuffless extraglottic airway device (EAD), the i-gel™ (Intersurgical, UK), has been released. The i-gel is a single-use, anatomically designed, cuffless EAD made of a gel-like thermoplastic elastomer (styrene ethylene butadiene styrene). It has features that are designed to facilitate insertion and maintain stability once inserted because of a built-in 'buccal cavity stabilizer' and no change in position associated with cuff inflation. There is a built-in bite block and an indicator to indicate the correct depth of placement. It fits snugly onto the peri-laryngeal anatomical framework, sealing the laryngeal inlet and has an epiglottic blocker which prevents epiglottic down-folding during insertion (Figure 1). The lack of an inflatable cuff also eradicates tissue compression associated with cuff inflation and problems associated with an air-inflated cuff during changes in ambient pressure in a hyperbaric environment. It is available in three sizes at present (size 3 for adults up to 60 Kg, size 4 60–90Kg and size 5 >90Kg).

The i-gel has features that separate the respiratory tract from the gastro-intestinal tract (GIT). A gastric channel enables access to the upper GIT, through which a gastric tube can be passed (French 12-gauge for sizes 3 and 4, and French 14-gauge for size 5), and an airway channel with a standard 15 mm port provides ventilation.<sup>2</sup> Its wide, short ventilation stem may be an ideal conduit for intubation either blindly (where it suffers the same disadvantage as the laryngeal mask technique in that it is almost impossible to remove the device once the patient is intubated), or with the aid of a fiberoptic and Aintree catheter. Guidelines from the manufacturer indicate that a size 6 endotracheal tube can pass through a

size 3 i-gel and a size 7 ETT through a size 5 i-gel, and a recent case report has confirmed this.<sup>3,4</sup>

However, currently there is a paucity of published data concerning its use in anaesthesia or resuscitation. Recent reports suggest that the i-gel would be applicable for use by non-medical personnel because of ease of insertion following minimal training, with insertion times comparable to that of the classic laryngeal mask airway (cLMA).<sup>5,6</sup>

A study was designed to test the suitability of the i-gel for use by diver medical technicians (DMTs) in a hyperbaric environment.

### Methods

#### USE OF THE i-gel AS AN AIRWAY DEVICE DURING GENERAL ANAESTHESIA

Hospital ethics approval was obtained to use the i-gel on patients undergoing anaesthesia. Assessment was made during general anaesthesia of the ease of insertion, any trauma produced, the ability to use both spontaneous and intermittent positive-pressure ventilation (IPPV) and to define any other problems associated with its use. In twenty patients who would have undergone anaesthesia using the cLMA, the anaesthetist was asked to substitute the i-gel for the cLMA. The anaesthetists involved (except for the author) had no prior training with insertion of the i-gel and received only verbal instructions by the author (these instructions were from the manufacturer's instruction manual) on how to insert it.<sup>4</sup> Once the i-gel was inserted auscultation was used to confirm bilateral lung ventilation and to detect any gastric inflation. Data collected are outlined in Table 1.

**Figure 1**  
The i-gel™ cuffless extraglottic airway device



#### USE OF THE i-gel BY DIVER MEDICAL TECHNICIANS

DMTs were trained in its use and a comparison was done with the cLMA because the Diving Medical Advisory Committee (DMAC) has recommended DMTs use the cLMA in a DB or DDC.<sup>7</sup> Twenty four DMTs (four on refresher courses and 20 undergoing training for the first time) participated in the study. All were instructed on the insertion of the cLMA on the Laerdal Airway Trainer manikin in accordance with published guidelines.<sup>8</sup> The Laerdal Airway Trainer has been shown to be suitable for training in the use of a wide variety of EADs.<sup>9</sup> Following informed consent, the DMTs were

then supervised with insertion of the cLMA in anaesthetised patients in the operating theatre.

Following a demonstrable competence with cLMA insertion, the DMTs were then instructed on the insertion of the i-gel (size 4) on the Laerdal Airway Trainer manikin. Insertion time and the number of insertion attempts were recorded. The DMTs were then instructed to insert a cLMA and i-gel from two positions: facing and alongside the manikin's head. Time taken and ease of insertion were again noted. The DMTs were then asked which device they preferred and why.

#### TESTING OF THE i-gel UNDER HYPERBARIC CONDITIONS

At 203 and 284 kPa pressure (90 and 60 minutes' exposure respectively) the i-gel was subjectively tested for a change in stiffness by a nurse inside a hyperbaric chamber. Following decompression the i-gel was examined for bubbles using a magnifying glass. The i-gel was then subjected to 608 kPa pressure for six hours and decompressed rapidly and examined again for bubbles.

#### Results

##### USE OF THE i-gel AS AN AIRWAY DEVICE DURING GENERAL ANAESTHESIA

A single insertion attempt was required in the majority of patients and all the insertion times recorded were less than 10 seconds. Insertion and adequate airway control was achieved in four patients with limited mouth opening (< 2.5 cm). There was one recorded failed insertion (by the author) but this patient had to be intubated following a failed attempt at insertion of a cLMA. This patient had a high arched palate which, in the author's clinical experience, has made insertion of the cLMA difficult. The majority of the patients had a period of intermittent positive pressure ventilation (IPPV) prior to the resumption of spontaneous ventilation, during which no gastric ventilation was detected following insertion. There were two recorded difficulties with insertion. In the first, the i-gel was not inserted deep enough on the first attempt because the patient was not anaesthetised adequately; whilst in the other difficulty was noted with passage over the patient's tongue with limited mouth opening.

In two patients the leak or seal pressure increased from 25 cm H<sub>2</sub>O to 30 cmH<sub>2</sub>O; both had operative procedures that lasted 60 minutes. All leak pressures were greater than 20 cmH<sub>2</sub>O. Airway trauma during insertion was minimal; one patient complained of a sore tongue and another of discomfort when swallowing oral medication prior to discharge. No blood was evident on the i-gel following removal even when used on an anticoagulated patient. These results are summarised in Table 1.

## USE OF THE i-gel BY DIVER MEDICAL TECHNICIANS

When standing at the head of the manikin, 18 of the 24 DMTs inserted the i-gel with the first attempt, with insertion times less than 15 seconds. No more than two attempts were needed to successfully intubate the manikin. This was better than insertion times and attempts with the cLMA; 14 achieved insertion with one attempt, six with two attempts and two required three attempts. Some DMTs required correct orientation of the cLMA with a fully deflated cuff prior to insertion, however, all had the correct orientation with i-gel. Insertion times for the two devices were comparable.

With the operator standing alongside the manikin's head or with the operator facing an upright manikin, insertion times and failure rates increased with the cLMA but not with the i-gel. Half the DMTs failed to achieve an airway using the cLMA with the manikin in the upright position even after three attempts.

All the DMTs preferred the i-gel to the cLMA when questioned because it was easier to use, easily inserted and didn't require them to remember to inflate a cuff.

## THE i-gel UNDER HYPERBARIC CONDITIONS

Subjectively there was no change in consistency of the i-gel at 203 and 283 kPa pressure. No bubbles were detected following decompression from 203, 283 or 608 kPa.

## Discussion

This study is consistent with other recently published studies confirming that the i-gel is a reliable airway device for anaesthesia.<sup>2,3,6,10</sup> The majority of anaesthetists in this study agreed that it had four advantages when compared to the cLMA: the lack of a cuff to inflate in an emergency; ease of insertion; the ability to pass a gastric tube and deflate the stomach; and insertion does not require placing a guiding finger in the patient's mouth as advocated by Brain in the placement of the cLMA.<sup>8</sup> The increase in seal or leak pressure noted with increasing time may be due to the thermoplastic properties of the gel cuff, which may make it a more efficient seal around the larynx following warming to body temperature.<sup>5</sup>

The low morbidity associated with the use of the i-gel in this study may have been due to the high success rate at first insertion and the flexibility of the non-inflatable cuff decreasing any trauma to the pharyngeal mucosa during insertion and decreasing the pressure exerted in the pharynx once inserted. Other studies have also shown that there are few complications associated with its use.<sup>3,5,6,10</sup> The lack of gastric inflation with IPPV would indicate that rescue breathing can be performed with the i-gel without inflating the stomach. There are increasing published data which advocate the use of the i-gel in cardiopulmonary resuscitation.<sup>3,5,6</sup> However, its ability to protect from pulmonary aspiration is yet to be conclusively demonstrated.<sup>2,10</sup>

**Table 1**

**Use of the i-gel extraglottic airway device for general anaesthesia**

Insertion attempts	DMTs successful
1	16
2	2
3	1
Failed	1
Difficulty with insertion	2
<b>Initial leak pressure</b>	
20 cmH <sub>2</sub> O	2
25 cmH <sub>2</sub> O	12
30 cmH <sub>2</sub> O	6
Increase in leak pressure	2
Stable once inserted	18
<b>Adverse effects</b>	
Gastric inflation	Nil
Sore throat	1
Blood on airway after removal	Nil
Other	1
BMI > 30	5
Limited mouth opening < 2.5 cm	4

DMT - diver medical technician

**Table 2**

**Comparison of the laryngeal mask airway (cLMA) and i-gel™**

	cLMA	i-gel
Easy insertion	Yes	Yes
Blind insertion	Yes	Yes
Ease of training	Yes	Yes
Use in CPR*	Yes	Yes
Aspiration risk	Yes	No data
Insert gastric tube	No	Yes**
Cuffed	Yes	No
IPPV	+/-	Yes
PEEP (up to 5 cms)	No	No data
Easily converted to ETT	Difficult	Yes***
Suction trachea	Yes	Yes
Stable once placed	+/-	Yes
Bite block needed	Yes	No
Finger-guided insertion	+/-	No
Insertion from any position	No	Yes

\* Includes manikin studies

\*\* when inserted correctly

\*\*\* Bougie or fibrescope required, blind intubation through device can be successful

Even though the cLMA is advocated by the Diving Medical Advisory Committee (DMAC), there are certain limitations for its use in a hyperbaric environment. These limitations are:

- an inability to decompress the stomach
- difficulty with insertion with the patient's head in the neutral position or if the patient is in the upright position with the operator facing the patient
- cuff expansion with a decrease in pressure on decompression
- a change in cuff volume due to gas diffusion as the gas mixtures breathed change.

These problems are not associated with the use of the i-gel. Gastric deflation is accomplished by the passage of a gastric tube via the gastric channel. Nitrogen has not been shown to be soluble in the material, nor is its function altered by an increase in pressure. Because the cuff is not gas-filled, the cuff's size and pressure will not be altered by changes in ambient pressure. Manikin training demonstrated that it can be inserted easily from any operator position (Table 2).

The i-gel is small and, therefore, can be stored easily in a DB or DDC. The demographic data of divers in the North Sea would indicate that a size 4 would be adequate for all divers; however, the sizes stored can be determined prior to the dive.<sup>11</sup>

### Conclusion

The problems associated with the use of the cLMA in emergency management (the lack of airway protection from aspiration, the risk of gastric inflation with IPPV and inability to decompress or suction the stomach) are not associated with the i-gel. The i-gel's design effectively isolates the respiratory tract from the gastrointestinal tract and allows IPPV without an airway leak or gastric inflation and allows the passage of a gastric tube to decompress the stomach. The i-gel was preferred to the cLMA by the DMTs involved in this study. The i-gel is recommended for use in resuscitation in a DB or DDC.

### Acknowledgement and conflicts of interest

The Intersurgical Company supplied the i-gels for use in this study.

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