Equipment

Evaluation of the Augustine Guide™ for difficult tracheal intubation

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Successful tracheal intubation with Augustine Guide™ (Augustine Medical, Inc., Eden Prairie, MN) in patients with normal airways has recently been described. There are no studies describing Augustine Guide (AG) use in patients with difficult airways. Accordingly, we studied AG intubation in a population of patients with expected difficult airways due to cervical spine pathology, limited mouth opening, obesity, facial trauma or deformity due to previous operation or radiation and in patients with unexpectedly difficult airways. A total of 44 patients were studied. The AG was used as a primary intubating tool in patients with known difficult airways (n = 36) and as a secondary intubating tool in patients with unexpected inability to intubate using conventional direct laryngoscopy (n = 8). Airway difficulty was predicted by history and physical examination. Intubations were performed under general anaesthesia in 40 of the 44 patients studied. In four patients with predictably difficult airways, topical anaesthesia and sedation were used. Backup methods to achieve intubation were available. Thirty-two of the 36 with known or suspected difficult airways were classified as Mallampati Class III or IV. In the remaining eight patients the preoperative examination suggested an easy airway; however, after induction of general anaesthesia, their laryngeal inlet could not be seen using direct laryngoscopy. Using the AG, all were intubated successfully (36/44 at the first attempt, in 8/44 repositioning of the AG to allow successful laryngeal entry of the stylet was necessary). There were no failures or complications secondary to AG use. This study shows that the AG is a useful device for oral tracheal intubation in patients with known or unexpectedly difficult airways.

La réussite de l'intubation trachéale avec le dispositif d'Augustine (Augustine Guide™, Augustine Medical Inc. MN) chez des patients aux voies aériennes normales a été récemment rapportée. Il n'existe toutefois pas d'étude décrivant l'utilisation du guide d'Augustine (GA) chez des patients dont l'accès aux voies aériennes est difficile. Dans ce but, les auteurs ont évalué l'intubation avec le GA chez des patients dont les voies aériennes étaient présumées difficiles d'accès à cause de pathologies de la colonne cervicale, de limitations à l'ouverture de la bouche, d'obésité, de traumatismes faciaux ou de difformités dues à des interventions antérieures ou aux radiations ainsi que chez des patients non susceptibles de causer de difficultés. L'étude incluait 44 patients. Le GA a été utilisé comme instrument d'intubation principal chez 36 patients connus pour accès difficiles et comme instrument secondaire chez huit patients avec des difficultés imprévisibles d'accès sous laryngoscopie conventionnelle directe. Les difficultés d'accès aux voies aériennes ont été prédites par l'histoire et l'examen physique. Pour quatre patients chez qui des difficultés étaient prévues, l'anesthésie topique et la sédation ont été utilisées. Des méthodes de rechange étaient prévues en cas de besoin. Trente-deux des 36 patients pour lesquels l'accès difficile était connu ou suspecté étaient classifiés III ou IV sur l'échelle de Mallampati. Chez les huit autres, l'examen préopératoire suggérait un accès facile; cependant, après l'induction de l'anesthésie générale, l'ouverture glottique n'a pu être visualisée sous laryngoscopie directe. Avec la GA, tous ont été intubés avec succès (36/44 au premier essai;

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chez 8/44, le GA a dû être replacé pour permettre l'introduction du mandrin dans le larynx). Il n'y a pas eu d'échecs ni de complications. Cette étude montre que le GA constitue un dispositif efficace pour l'intubation orotrachéale chez des patients dont l'accès difficile aux voies aériennes est auparavant connu ou inattendu.

The Augustine Guide™ (AG) is a recently introduced device designed to facilitate rapid, blind orotracheal intubation in adults. The device is made of molded plastic and is designed to fit in a lock and key fashion in the glottis (Figure). A specially designed stylet is advanced through the AG channel and an endotracheal tube is then advanced over the stylet into the larynx. Head and neck manipulation are unnecessary for AG use; in fact, a neutral head and neck position is maintained throughout AG intubation. The design, use, and potential advantages of this device have been described previously.[1] A prospective study described the successful use of the AG in patients with normal airways who presented for operations under general anaesthesia.[2] The authors reported a success rate of 94% and concluded that the AG was a safe and effective device for achieving rapid blind orotracheal intubation in patients with normal airways while maintaining the head and neck in a neutral position. In this report, we describe use of the AG in a population with anticipated or unexpected airway difficulty.

Methods

This report is a cohort review of cases in which the AG was used as a primary intubating tool in patients with difficult airways or as a secondary intubating tool after unexpected inability to intubate the trachea after conventional direct laryngoscopy. Permission to perform this retrospective review was obtained from the institutional review board of both institutions participating in the report. When the AG was used as the primary intubating tool, determination of the airway difficulty was based on previous inability to intubate by direct laryngoscopy or by medical history and clinical examination. The aetiological factors contributing to airway difficulty are listed in the Table. Clinical examination included measurements of mouth opening; evaluation of neck range of motion; examination for anatomical changes secondary to previous trauma, radiation, or surgery; and Mallampati classification according to the modification of Samsoon and Young.[3] Patients with contraindications to blind orotracheal intubation (e.g., retropharyngeal abscess), patients in whom mouth opening was severely restricted (less than 2 cm), and patients needing nasotracheal intubation were excluded from consideration. No patient with a known or suspected difficult airway was excluded for any other reason. Fibreoptic intubation equipment and other backup emergency airway equipment were available at all times. All intubations were performed in the operating room which included standard monitoring for general anaesthesia. In patients with known difficult airways, intubation with the AG was attempted either under general anaesthesia or after topical anaesthesia of the upper airway and sedation. The latter method was chosen when

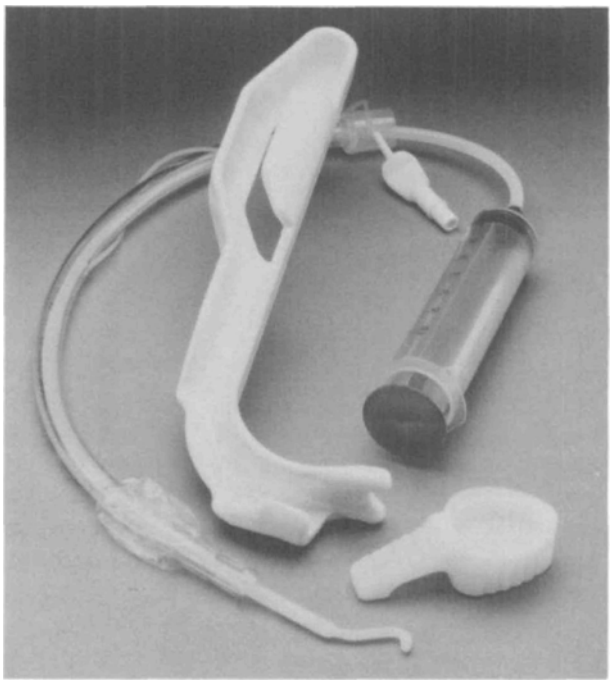

FIGURE The Augustine Guide. Molded plastic guide handle with channel for endotracheal tube and preinserted stylet. The bite block is used to maintain mouth opening during insertion.

TABLE Aetiological factors contributing to airway difficulty

Aetiologic factor/s	*Number*
Cervical spine pathology	8
– Rigid/due to arthritis	3
– Unstable/trauma, tumour	5
Facial trauma	9
Temporomandibular joint dysfunction with fixed limited opening	4
Maxillary alveolar abscess/facial oedema, limited opening unmodified by anaesthesia	4
Facial deformity/previous radiation or operation	6
Micrognathia/history of failed intubation	3
Morbid obesity	4
Obesity with bull neck/unexpected failed intubation	2
Obesity with sleep apnoea/unexpected failed intubation	1
Diabetes mellitus/history of impossible intubation	1
Acromegaly (macroglossia)/and TMJ ankylosis	1
Unknown/history of impossible intubation, "anterior larynx"	1

cervical spine stability was of concern. Both groups of patients were allowed to breathe spontaneously and assisted ventilation by mask was possible. The general anaesthetics consisted primarily of propofol and alfentanil or thiopentone, volatile agents, and fentanyl. All patients were denitrogenated with oxygen for three minutes prior to AG intubation. In some patients direct laryngoscopy was attempted prior to intubation with the AG. When this was done a Cormack and Lehane grade according to the modification of Samsoon and Young[3,4] was recorded.

When the AG was used as a secondary intubating tool, the tracheas were not expected to be difficult to intubate. Thus the patients were all anaesthetized, paralyzed, and assisted ventilation by mask was possible. During direct laryngoscopy, the vocal cords and laryngeal inlet could not be seen (Cormack and Lehane grade IV) and blind intubation was not successful. Intubation was then attempted using the AG.

The intubations were performed by four authors (RC, HR, KB, EB) who each had undergone previous AG intubation experience in order to learn the technique (approximately 12 intubations each during the learning process). Details of the AG intubation technique have been described.[1,2] Briefly, it involves opening the mouth in the neutral position, inserting a bite block between the molars on the right to hold the mouth open, grasping the tongue and withdrawing it anteriorly out of the mouth, and inserting the AG with a preloaded endotracheal tube and a special stylet until it locks in the glossoepiglottic fold. Proper AG position is confirmed by gentle left and right rotation of the AG handle which produces corresponding movements of the hyoid bone that are palpable on the anterior aspect of the neck. The stylet is then advanced into the larynx and the 35 ml syringe attached to it is quickly and fully aspirated. Free and easy return of air confirms successful placement of the stylet in the trachea. A vacuum-like effect or any limitation of air return indicates placement of the stylet into the oesophagus. After confirmation of tracheal stylet placement, the endotracheal tube is detached from the AG and advanced over the stylet into the trachea. The stylet and AG handle are then removed, the endotracheal tube connected to the ventilating apparatus and successful intubation confirmed using conventional criteria.

Results

Thirty-six patients with known or suspected difficult airways and eight patients with difficult airways discovered after failed conventional intubation were studied at the two institutions. Thirty patients were male, 14 were female. The range of ages was 21–70 yr with a mean ± SD age of 42.2 ± 14.9 yr. The range of weights was 45–158 kg with a mean ± SD weight of 79.6 ± 22 kg. Mallampati classification according to the modification of Samsoon and Young[3] was performed in 36 of 44 patients with the following distribution of classes: I-0, II-4, III-29, IV-3. Mallampati examination was performed as part of the airway evaluation in cases of anticipated difficult intubation. However, in no case was Mallampati class alone used as the only factor to classify an airway as difficult. Cormack and Lehane[4] grading of the view obtained on direct laryngoscopy was performed in 27 of 44 patients and they were graded as follows: I-0, II-0, III-10, IV-17. Direct laryngoscopy was not performed in 17 patients because of cervical spine instability (eight patients) or severely limited mouth opening rendering direct laryngoscopy impossible (nine patients).

The patients were classified with regard to factors contributing to difficult airway management (Table). The commonest problems encountered were cervical spine pathology or instability, considerably limited ability to open the mouth, facial deformities, and obesity. One patient had no obvious factor but an "anterior larynx" encountered on past direct laryngoscopy and a failed intubation. This patient had a Cormack and Lehane Grade IV view on direct laryngoscopy. Fractured mandibles were present in three of the patients.

In all 44 of these patients with known, suspected, or unexpectedly encountered difficult airways the tracheas were successfully intubated using the AG. No patient suffered oxygen desaturation below 95% detected by pulse oximetry during intubation attempts. In all but eight patients, intubation was successful on the first attempt. These eight patients required repositioning of the AG to allow successful laryngeal entry of the stylet. In these patients, the lungs were ventilated by mask between attempts. No consistent factor was identified as a reason for the required repositioning of the AG in these patients. Similarly, we could not recognize any single factor that resulted in a successful second attempt. The 18% (8/44) rate of a second attempt required in this population with difficult airways is similar to the 23% rate of two attempts required in the earlier study of AG use with normal airways.[2] Intubation time ranged from 30–120 sec from the initiation of AG intubation. Single attempt intubations required 30–60 sec. In the patients requiring a second attempt, all intubations were within two minutes of the initiation of AG intubation. In no patient identified as possessing a difficult airway was intubation using the AG unsuccessful. No patient suffered serious complication or injury as the result of AG intubation.

Discussion

Experience at two institutions using the AG to intubate the trachea in patients with difficult airways demonstrates

that the AG is a safe, effective tool for achieving orotracheal intubation in the management of difficult airways due to a wide variety of causes. Indeed, the AG may offer unique advantages in certain clinical situations, namely when the maintenance of neutral head and neck position is critical and when blood in the oral cavity may make fibreoptic intubation difficult. Being a blind technique, AG intubation is not adversely affected by blood or secretions obscuring laryngeal visualization as occurs with fibreoptic techniques. Even very small amounts of blood or secretions can make fibreoptic visualization difficult. When using the AG, it is important to know in advance the source of blood in the oral cavity. An injury below the level of the base of the tongue would preclude use of a blind orotracheal intubation technique such as the AG (a false passage could be created). However, if blood in the oral cavity is from a source higher in the oropharynx or nasopharynx, the AG technique offers considerable advantage over fibreoptic techniques. In addition, AG intubation requires no light source or power supply. The AG unit is fairly compact, therefore allowing easy storage and accessibility for use in cases of unexpected failed intubation. In the current report, unexpected failed intubation after conventional direct laryngoscopy occurred in eight adults who were already anaesthetized and paralyzed. Fortunately, it was possible to provide ventilation by mask and orotracheal intubation was successfully accomplished using the readily available AG kept in the operating room. This eliminated time which would have been wasted waiting for less easily available specialized intubation equipment.

The AG offers an advantage over transtracheal jet,[5] mini tracheostomy,[6] and percutaneous retrograde stylet[7] techniques in that the AG is not an invasive technique and so there is no direct risk of pneumothorax, severe bleeding, infection or other complication due to technical misadventure. In an earlier study, AG use was associated with an 18% incidence of minor injury to the oral mucosa (most frequently to the frenulum or underside of the tongue); no serious complications were noted.[2] Similar findings occurred in this group of patients with difficult airways; the only injuries were minor lacerations of the lip or underside of the tongue. It is critical, however, that operators learn proper AG intubation technique as injury from improper use of the stylet, guide, or an improperly directed endotracheal tube could occur.

The AG offers an advantage over lighted stylet[8] techniques in that the AG is made to fit in a lock and key fashion into the supra laryngeal anatomy and so the chances of proper tracheal intubation are increased. Indeed, the incidence of oesophageal intubation during AG use in this and the previously reported study was zero.[2]

The AG offers an advantage over the laryngeal mask airway,[9] oesophageal obturator airway[10] and the oesophageal tracheal combitube[11] in that it secures an endotracheal airway with greater protection against the risk of gastric content aspiration. Only the oesophageal tracheal combitube may result in successful tracheal intubation, but the chance of this happening with blind insertion is remote.[12] In addition, the oesophageal obturator and oesophageal tracheal combitube possess the risk of oesophageal mucosal laceration or perforation. Also in the two latter techniques, tracheal suctioning is not possible. Ventilation via an endotracheal tube may be preferred in patients needing higher inflation pressures. This may not be possible with the laryngeal mask airway, oesophageal obturator airway, or oesophageal tracheal combitube.

The laryngeal mask airway has been used in conjunction with the fibreoptic bronchoscope to secure an endotracheal airway in cases of difficult intubation. This introduces the difficulties associated with fibreoptic techniques mentioned above. The practitioner then has to be proficient at laryngeal mask insertion and fibreoptic intubation, and also needs additional equipment in order to accomplish successful tracheal intubation via this route. In addition, size 6 mm internal diameter endotracheal tubes are the largest that can be inserted in this fashion. The AG allows insertion of size 7 mm or 8 mm internal diameter endotracheal tubes.

As with any other piece of anaesthesia equipment or airway device, it is critical that practitioners learn the proper use of the AG in order to consistently achieve successful intubation. In contrast to Kovac's report,[13] we found that practitioners, knowledgeable in airway management, require brief instruction from someone familiar with the technique and supervised use in approximately 12 patients before consistent success is achieved. Instructional videotapes are available from the company that manufactures the AG. In using the AG in patients with normal airways in the earlier report, the authors did not see a typical learning curve with early difficulty and proficiency achieved with further use (Carr RJ, Belani KG: personal communication). Indeed the majority of failures to intubate using the AG in that study occurred between patients 50 and 60. Another interesting observation was that in three patients with normal airways, the trachea could not be intubated using the AG but it was easy to intubate by direct laryngoscopy.[2] In the current report, in all 44 patients with difficult airways the tracheas were successfully intubated with the AG. We believe this is explained by the fact that AG intubation is fundamentally different from direct laryngoscopic intubation. In direct laryngoscopy, it is necessary to look around a corner; in AG intubation, the guide reaches around the corner. Because of this fundamental difference, the predictive fac-

tors for difficult direct laryngoscopy do not necessarily apply to AG intubation. At the same time, the fact that three of 100 patients in the original study had normal airways and easy direct laryngoscopies but in whom the trachea could not be intubated with the AG suggests that there may be a factor or factors that contribute to difficult AG intubation but do not contribute to difficult direct laryngoscopy. We have not been able to identify such a factor.

Although limited mouth opening was an important aetiological factor for difficult conventional intubation in the cases reported here, extreme care must be taken in the preoperative evaluation of such patients. A minimum distance of 2 cm between the upper and lower teeth is required to insert the AG. Therefore, in patients with mouth opening limited so as to make direct laryngoscopy difficult, AG intubation may or may not be a viable alternative.

As with other specialized airway management techniques, regular practice in a controlled setting with normal airways is required to learn and maintain AG intubation skills. Practitioners should not attempt using the AG in patients with difficult airways when they have not practiced its use in routine cases.

In summary, this report provides evidence that the AG is a useful device which should be included in the anaesthetists' airway management armamentarium. It was useful in the management of patients with difficult airways from a variety of causes, especially in cases where maintenance of neutral head and neck position was critical.

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