

Anaesthetists' practice of awake fiberoptic intubation in adult patients

Elizabeth van Rooy

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fulfilment of the requirements for the degree of Master of Medicine in Anaesthesiology.

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Declaration

I, Elizabeth van Rooy, herewith declare that this research report is my own work. It is being submitted to the University of the Witwatersrand, Johannesburg, for the degree of Master of Medicine. It has not been submitted previously for examination to this, or any other academic institution.

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Dedication

I dedicate this work to my husband, Herrie, who has always believed in me and provided me with endless support, as with all my other endeavours.

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Abstract

Background

Awake fiberoptic intubation (FOI) remains the gold standard management of the anticipated difficult airway. An organised approach will ensure success and patient comfort. Training has to be rigorous to instil confidence. Exposure, practice and level of confidence of awake FOI in the Department of Anaesthesiology at the University of the Witwatersrand (Wits), is not known.

Methods

Anaesthetists were surveyed with an anonymous self-administered questionnaire. A total of 130 questionnaires were distributed at departmental academic meetings over five months and 126 (96.9%) questionnaires were returned.

Results

The majority (41.2%) had only performed one to five awake FOIs, 12.7% had performed 21 to 50, but 13.5% had never performed any. The majority were trained on asleep (39.8%) and awake (31.9%) patients. Only 20.4% had manikin, and 4.2% simulator training. While 58.7% had reasonable levels of confidence, 41.3% had low confidence. Midazolam (35.0%) and fentanyl (26.7%) were the most commonly used drugs for sedation followed by remifentanyl (16.1%) and dexmedetomidine (12.2%). All topicalised the airway prior to awake FOI. Lignocaine 2% was the drug of choice (72.2%). Techniques included application of soaked swabs (23.4%), spray (22.8%), spray-as-you-go (18.7%), nebulisation (16.4%), gel or ointment (8.8%), transtracheal block (6.4%) and gargle (2.9%).

Conclusion

Anaesthetists in the Wits Department may not be adequately exposed to awake FOI and demonstrated a marked variability in sedation and topicalisation practices.

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List of abbreviations

ASA - American Society of Anesthesiology

FB - Fibreoptic bronchoscope

FOI - Fibreoptic intubation

ETT - Endotracheal tube

NAP4 - Fourth National Annual Project

TCI - Target controlled infusion

Section 1: Literature review

1.1 Introduction

One of the most important tasks of the anaesthetist is airway management. It is critical that the anaesthetist is familiar with the mechanisms responsible for predicting a difficult intubation and knows how to handle these challenges (1).

Airway complications are the most common anaesthetic cause of morbidity and mortality. An estimated one third of anaesthetic deaths occur as a result of failure to establish an airway and failure to ventilate (2).

According to the American Society of Closed Claim Analysis, respiratory complications were responsible for 37% of anaesthetic adverse events. Of these, 72% of the incidents were considered preventable. Difficult tracheal intubation rated amongst the most common causes of brain damage and death (3).

The American Society of Anesthesiology (ASA) guidelines for management of the difficult airway, strongly recommends that the “strategy for intubation of the difficult airway should include the identification of a primary or preferred approach to awake intubation”. In a survey amongst ASA members, 69% of the consultants strongly agreed that the fiberoptic bronchoscope (FB) should be available even for emergency airway management (4).

Awake fiberoptic intubation (FOI) remains the gold standard for the management of the anticipated difficult airway in a spontaneously breathing patient (5, 6). By extrapolating the findings of Lee et al. (7) who stated that the Trachway® is preferred to the FB when managing the difficult airway, Ahmad et al. (8) proposed that asleep videolaryngoscopy should be the new gold standard. Heidegger (9) and Schechtman et al. (10) however emphasized the contrary and encouraged anaesthetists to undergo training and master the technique of FOI (11). Wiles (12) concluded that clinical cases requiring FOI will always remain and anaesthetists should be careful not to neglect this skill. Awake FOI may be the only possible way of securing a definitive airway in certain clinical scenarios for example in a patient who has severe trismus (13). In the fourth National Audit Project (NAP4), the Royal College of Anaesthetists emphasised that awake FOI was underutilised when managing a difficult airway (14). Failing to use FOI when indicated could result in airway complications and jeopardise patient safety (15). In view of its importance, training in FOI is given at the annual ASA conference (16).

The FB is of further value to the anaesthetist when extubation has to be carefully timed as would be the case in vocal cord dysfunction or swelling of the airway (17). In addition, using the FB is superior to clamping and auscultation to confirm optimal placement of a double-lumen tube (18). The FB is a helpful tool in the intensive

care unit where it can be utilised by the trained anaesthetist to perform diagnostic bronchoscopies as well as clear secretions from the airway (19).

1.2 History

Awake FOI was founded by Dr Peter Murphy in 1965 when he became the first to intubate a patient's trachea aided by the choledochoscope. Dr Murphy was a senior registrar in anaesthesia at the National Hospital for Nervous Disease in London at the time. He obtained a flexible choledochoscope from the American Cystoscope Makers Inc. and used it to obtain the first fiberoptic images of the airways during endotracheal intubation (19).

In the Classic Papers series published in 2010 in the journal *Anaesthesia*, Calder (19) explained how Dr Murphy's newly described technique resonated with the otolaryngologists long before the anaesthesia community realised its value. In 1972 Dr Murphy convinced his department to buy a flexible fiberoptic laryngoscope. He described his initial attempts to intubate with this apparatus as "embarrassing", especially because he was considered the forerunner in the field. He proceeded by attempting intubation in the post-anaesthesia unit where patients' muscle relaxants had worn off. As Dr Murphy's skills improve he became highly sought after by the head and neck surgeons.

The first FB was designed in the 1960's by Shigeto Ikeda from Japan, and advanced by Chevalier Jackson who added a suction channel (20). The evolution of the flexible FB has resulted in the development of the video bronchoscope (5). The video bronchoscope is regarded as easier to use as it provides a much wider, magnified view and therefore the anatomy is easier to recognise. It also allows multiple observers and is therefore a good teaching tool (21).

1.3 Indications and contraindications

Awake FOI is the standard approach in the clinical scenario where endotracheal intubation is indicated, but mask- and supraglottic ventilation is not likely to be successful. An awake FOI protects against the danger of the "cannot intubate cannot ventilate" situation following the induction of a general anaesthetic. Awake FOI should be considered in cases of trauma to the face and neck, head and neck tumours, obstructive sleep apnoea, obesity, abnormal airway anatomy and previous difficult intubation (5). Awake FOI supersedes other intubation techniques like video laryngoscopy in patients with severely limited mouth opening (22). Awake FOI is also the preferred technique in cervical spine injury or instability (5, 23). Manipulation of the airway is thereby minimised and should prevent neurological injury. The patient can be examined following awake FOI to detect any new onset neurological deficit or deterioration in neurological function (5).

Absolute contraindications relate mostly to patient non-compliance as well as the patient refusing awake FOI despite comprehensive counselling. An inexperienced anaesthetist, patient allergy to local anaesthetic agents, bleeding or contamination of the airway and stridor due to tumours of the upper airway, are relative contraindications (22, 24). Safety in a patient with an increased aspiration risk is debatable (22), but awake FOI may reduce this risk by maintaining protective reflexes (5). Awake FOI should however be avoided in a patient who is vomiting (25).

1.4 The flexible bronchoscope

The FB is a delicate instrument that has to be meticulously maintained, cleaned and handled with care (26). The components of the FB are illustrated by Figure 1. It consists of a body and an insertion cord (5). The body contains the eyepiece (1), focusing ring (2), angulation control lever (3), light source adapter (4) and instrument channel (5). The insertion cord (6) comprises a column of multiple thin, flexible glass fibreoptic bundles. By the principle of total internal reflection the fibres allow an image to be transmitted from its distal end, along the length of the fibrescope, to the eyepiece located proximally. The fibres are insulated by thin layers of glass with different optical densities. Light is reflected internally along the length of the fibres. Lenses at the tip of the scope and the eyepiece allow focus of the image (2, 5).

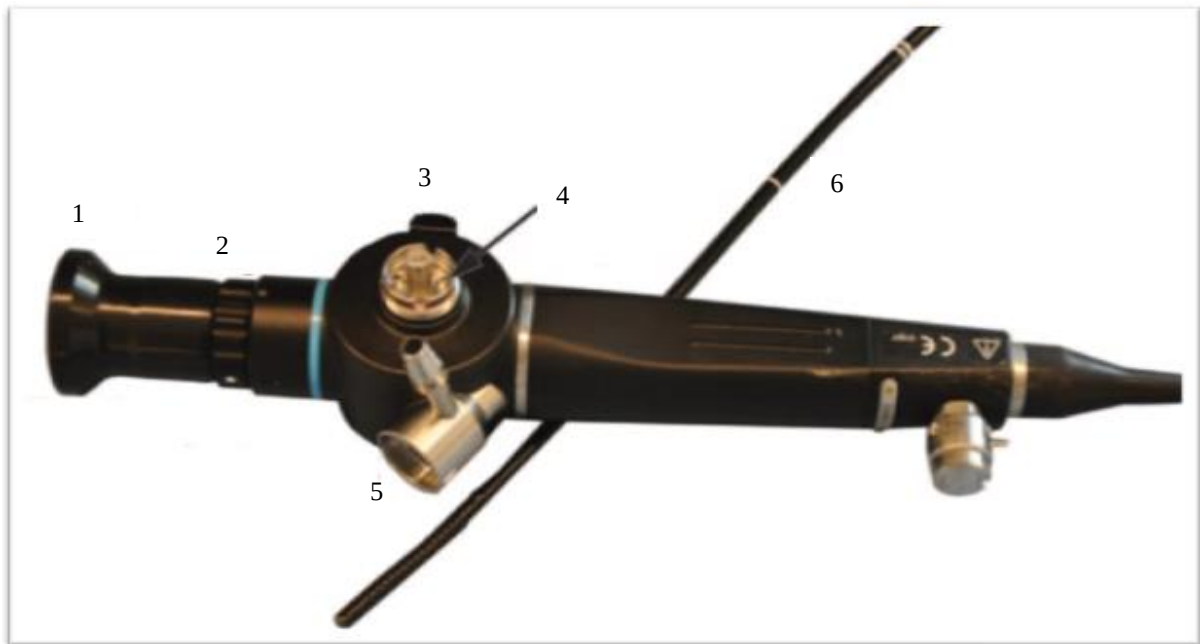


Figure1: The flexible bronchoscope (5)

1.5 Preparation

Awake FOI has to be carefully planned in order to optimise patient comfort, intubation conditions and haemodynamic status (27). Standard emergency airway equipment and drugs should be available (5). All

anaesthetic and resuscitation equipment should be checked according to a standardised protocol (28).

Intravenous access must be obtained prior to the procedure (2).

1.5.1 Psychological preparation

It is important to thoroughly explain every step of the procedure prior to initiation and to continuously engage with the patient during the intubation (24). The patient should understand why this particular technique has been chosen (28) and be reassured that comfort and safety will be optimised (5). It is advisable to give the patient specific instructions for example to rather raise his or her hand if the anaesthetist should pause and not to speak during the procedure. A well-informed patient is likely to be cooperative, allowing the intubation to proceed more smoothly (28).

1.5.2 Positioning

The patient should be in the seated or supine position and continuous monitoring should be in place (5). In their case report, Dabbagh et al. (29) described a dyspnoeic, agitated patient with a rapidly enlarging neck mass who could not tolerate the supine position. The authors suggested that the anaesthetist should practice performing awake FOI in patients in the sitting position as well (29).

Awake FOI may also be performed in the lateral position if necessary to maintain the patency of the airway as described by Neumann et al. (30).

1.5.3 Premedication

It is advisable to administer an antisialogogue to reduce airway secretions. By maintaining a dry airway, the anaesthetist's view remains unobscured and the topical application of local anaesthetic is more efficacious (28). Glycopyrrolate is the drug of choice as it does not cause sedation and has a rapid onset of action (5). Collins et al. (5) recommended 0.1 to 0.2 mg glycopyrrolate intravenously while Slavkovic (25) used 0.2 to 0.4 mg. Alternatives include atropine, scopolamine (5) and hyoscine (22). Administration of intravenous glycopyrrolate should be 20 minutes prior to the intubation (16). The resultant tachycardia caused by its antimuscarinic action could be troublesome especially in very anxious patients. This adverse effect could be reduced by intramuscular administration of the antisialogogue one hour before the procedure at a dose of 4 µg.kg⁻¹ (22).

If indicated, metoclopramide and ranitidine should be administered at least one hour before the procedure to reduce the volume and increase the pH of the gastric contents (31-33).

In patients who are extremely anxious, an oral anxiolytic may be of value (28).

1.5.4 Sedation

Ideally, a patient undergoing awake FOI should be cooperative, comfortable, well analgised, maintain their own ventilation and have no airway secretions. The drug chosen for sedation should therefore be easily titratable, short acting and should cause little suppression of respiration (34). As the safety of awake FOI relies on the patient breathing spontaneously, it is advisable that a second anaesthetist is present to administer sedation. Over sedation may cause apnoea and hypoxia while under sedation may result in the patient being uncooperative (22). The question may arise as to whether sedation should be given at all in view of the risk of compromising the airway and the resultant hypoxaemia (5). Ho et al. (35) and McGuire et al. (36) have reported cases of complete obstruction of the airway while attempting awake FOI in the absence of sedation. Also, awake FOI may cause significant discomfort in 20% of patients even with appropriate premedication and titrated sedation (37). A variety of drug combinations to facilitate awake FOI have been described over the past 30 years including propofol, benzodiazepines, opioids, ketamine and α -2-adrenoreceptor agonists. The practitioner has to select the ideal drug based on the particular patient and indication for awake FOI (38). Unfortunately, appropriately-designed randomised control trials demonstrating superiority of certain drug combinations, are lacking (22). Intravenous midazolam administered in small boluses is a popular choice because of its ability to provide sedation and anterograde amnesia. A short acting opioid such as fentanyl should be administered simultaneously to suppress coughing, depress laryngeal reflexes and offer analgesia (28). This regimen is simple and has been widely used. The total dose of midazolam should not exceed 0.05 mg.kg^{-1} and that of fentanyl, $1.5 \text{ }\mu\text{g.kg}^{-1}$ (22). Achieving the desired level of sedation with propofol alone is extremely difficult (22). If propofol is selected for sedation during awake FOI it should be administered as a target controlled infusion (TCI) together with remifentanyl (38).

Remifentanyl and dexmedetomidine are attractive choices because of their unique characteristics (38). Remifentanyl is an ultra-short acting opioid with a constant half-life (38) resulting in quick termination of its action (22). It suppresses the cough reflex and blunts the cardiovascular responses brought on by airway manipulation (38). Remifentanyl has been effective as a single agent for sedation in awake FOI but because of the high occurrence of memory recall, additional agents may need to be administered (22). Adverse effects of remifentanyl include hypotension, rigidity of the chest wall (22), respiratory depression and bradycardia (38). Remifentanyl can however be reversed by an antagonist (38), naloxone, even though higher than usual doses may be required when compared to reversal of other opioids (39).

Dexmedetomidine is a selective α -2-adrenergic agonist that acts on the central nervous system (38) to cause sedation, analgesia and anxiolysis (22). Dexmedetomidine has a linear pharmacokinetic profile (40) and a loading dose of 0.7 to 1 $\mu\text{g.kg}^{-1}$ over 10 to 20 minutes should be administered for awake FOI (38). Clinical advantages in awake FOI are similar to that of remifentanyl but in addition, dexmedetomidine provides desirable amnesia and does not cause respiratory depression (22).

A summary of selected literature pertaining sedation for awake FOI is provided in Table 1.

Table 1: Sedation for awake FOI

Author	Method	Conclusion
Puchner et al. (41)	Evaluated remifentanyl as a single drug for awake FOI as compared to fentanyl plus midazolam.	High doses of incremental remifentanyl (0.1 to 0.5 $\mu\text{g.kg}^{-1} \cdot \text{min}^{-1}$) improved the intubating conditions but patients were more likely to recall details of the procedure.
Machata et al. (27)	Compared two different continuous infusion dosage regimens of remifentanyl for awake FOI.	Recommended a remifentanyl bolus of 0.75 $\mu\text{g.kg}^{-1}$ over 30 seconds at the onset followed by 0.075 $\mu\text{g.kg}^{-1} \cdot \text{min}^{-1}$. Doubling the doses did not show additional benefit and was associated with dose dependent respiratory suppression and increased levels of partial pressure of carbon dioxide. The authors recommend intravenous midazolam 0.05 mg.kg^{-1} as a premedication.
Lallo et al. (42)	Compared the efficacy and titratability of remifentanyl versus propofol when administered as a TCI during awake FOI.	Propofol and remifentanyl can be rapidly titrated according to patient response but propofol caused significantly more sedation.

Author	Method	Conclusion
		Patients receiving remifentanyl were more cooperative. Remifentanyl was a superior choice especially when continuous spontaneous ventilation was essential.
Bergese et al. (43)	Assessed whether dexmedetomidine was safe and effective when applied as the main sedative for a patient undergoing awake FOI.	Dexmedetomidine was a suitable alternative agent to sedate patients undergoing awake FOI. When dexmedetomidine was given, less rescue midazolam was required as compared to placebo. Dexmedetomidine lowered the heart rate and blood pressure and was associated with greater intubation success rate in Mallampati class IV airways when compared to placebo.
Bergese et al. (44)	Compared dexmedetomidine plus midazolam versus midazolam as a single sedative for awake FOI.	Dexmedetomidine rendered patients significantly more cooperative and calm as compared to midazolam. An infusion of dexmedetomidine following premedication with midazolam was more effective than using repeated doses of midazolam only for conscious sedation during awake FOI.
Ryu et al. (45)	Compared outcomes of patients	Propofol-dexmedetomidine

Author	Method	Conclusion
	undergoing FB when sedated with propofol-remifentanil versus propofol-dexmedetomidine.	administration resulted in fewer episodes of desaturation and fewer airway secretions but patients required more topical anaesthesia and took longer to recover. In addition, bronchoscopist satisfaction was lower with this combination.
Cattano et al. (34)	Compared remifentanil versus dexmedetomidine as anaesthetic agents for awake FOI.	Remifentanil use resulted in a higher success rate with the initial attempt. Patients receiving dexmedetomidine were much slower to attain adequate levels of sedation but memory recall was lower in this group. Dexmedetomidine could be valuable in awake FOI but “mid-level providers” of anaesthesia will find remifentanil more beneficial.
Dhasmana S. (46)	IVI Dexmedetomidine $1.0 \mu\text{g.kg}^{-1}$ was compared with $1.5 \mu\text{g.kg}^{-1}$ for awake FOI.	Haemodynamic parameters were not significantly different between the groups but patient cooperation and satisfaction were superior with $1.5 \mu\text{g.kg}^{-1}$.
Eftekharian et al. (47)	Compared remifentanil, ketamine and propofol for sedation during awake FOI.	Remifentanil was superior to the other two drugs with regards to time taken to intubate, intubating conditions and patient satisfaction.
Ovassapian A. (48)	Recommended titrated boluses of	This technique is taught in the Wits

Author	Method	Conclusion
	fentanyl (average dose of 1.5 $\mu\text{g.kg}^{-1}$ to suppress airway reflexes) and midazolam (average dose of 30 $\mu\text{g.kg}^{-1}$ to prevent memory recall).	Department of Anaesthesiology and is referred to as the Ovassapian technique.

1.5.5 Airway anaesthesia

The airway has to be sufficiently anaesthetised prior to an awake FIO to ensure patient cooperation and comfort (23). It improves patient tolerance and acceptability and limits the use of sedation especially when haemodynamic stability is essential (49). The combination of local anaesthetics and systemic narcotics decreases the risk of toxicity of a drug and limits the discomfort of the intense airway stimulation brought on by awake FOI (50). Lignocaine is most commonly used as other local anaesthetic agents such as benzocaine and tetracaine have a narrow therapeutic window and are associated with methaemoglobinaemia (5, 6).

Various techniques should be combined to achieve adequate anaesthesia of the airway (51). For a nasal intubation, the mucosa of the nose has to be anaesthetised targeting the V1 and V2 trigeminal nerve branches. This can be achieved by directly applying swabs to the mucosa that has been soaked in lignocaine. Ideally a 0.25% phenylephrine solution should be applied simultaneously to constrict the blood vessels of the mucosa and thereby prevent epistaxis (5). Cocaine used to be applied for this purpose (6) but it is a controlled drug and has now largely been replaced by a combination of lignocaine and phenylephrine, due to its significant adverse effects (52). The toxic dose of cocaine is variable but mostly reported as 3 mg.kg^{-1} in adults (53). Cara et al. (54) compared pain scores reported by patients undergoing placement of a nasal tube following topical application of cocaine 5% or a combination of phenylephrine 0.5% and lignocaine 5% but found no significant differences. They concluded that even though phenylephrine could result in hypertension and bradycardia, it is still favourable compared to cocaine which not only causes ischaemia of the myocardium, but also poses a barrier with regards to ordering, storing and dispensing of the drug (54). Ovassapian (55) recommended a lignocaine 4% solution as this delivered satisfactory local anaesthesia with a low risk of toxicity provided that a total dose of 3 to 4 mg.kg^{-1} is not exceeded. Alternatively lignocaine can be applied as a gel (2%) or ointment (5%) to the nasal mucosa (5). A lignocaine 10% solution should not be applied undiluted as this will result in a stinging sensation of the mucosa (56). The onset of action of lignocaine when applied in this fashion is up to five minutes (57) so adequate time should be allowed prior to manipulation of the airway (6).

To anaesthetise the tongue, oropharynx and larynx, lignocaine can be gargled, nebulised or aerosolised. These techniques target the V3 branch of the trigeminal nerve as well as the glossopharyngeal- and vagus nerves (5). Lignocaine can also be sprayed onto the base of the tongue and the pharynx keeping in mind that each spray dispenses 10 mg of the drug (32).

The larynx is further anaesthetised by using the spray-as-you-go method (6). By utilising the instrument channel of the FB (5), a dose of local anaesthetic is sprayed directly onto the vocal cords when visualised (6, 32) followed by a second dose sprayed onto the tracheal mucosa as soon as the FB passes through the vocal cords (6).

Regional airway blocks can be used as an alternative to topicalisation, or to enhance its effect, but depends on physician experience and patient acceptability. The rapid onset and longer duration of action are definite advantages of airway blocks (5). A transtracheal block is performed by inserting a 22-gauge needle through the cricothyroid membrane into the tracheal lumen, aspirating air to confirm positioning and then injecting lignocaine into the trachea (51) in a caudad direction (33). A vigorous cough reflex will be provoked and the local anaesthetic is then sprayed over the area (33), thereby blocking the recurrent laryngeal nerve (51). The superior laryngeal nerve can be blocked by holding a cotton swab soaked in lignocaine with a Kraus forceps against the mucosa of the piriform fossa for approximately one minute (51, 58).

Complications of airway blocks include intra-arterial injection, bleeding and injury to local structures (5). In view of the potential trauma to the carotid arteries as well as prolonged suppression of airway reflexes, blocking the glossopharyngeal nerve by needle infiltration of the tonsillar pillars is discouraged (32). This involves infiltration of lignocaine at the level of the thyrohyoid membrane, just inferior to the cornu of the hyoid bone (59). Table x provides an overview of the airway nerve supply, anatomy and the techniques which may be applied to anaesthetise the airway for awake FOI.

Table 2: Airway nerve supply and anaesthetic techniques

Nerve	Supply	Technique
Trigeminal	Tongue, oropharynx, larynx	Topicalise
Glossopharyngeal	Tongue, vallecula, epiglottis, tonsils, pharynx	Topicalise, direct infiltration
Vagus - superior laryngeal	Tongue, epiglottis, arytenoids	Direct infiltration at greater cornu of hyoid
Vagus - recurrent laryngeal	Trachea, vocal cords	Topicalise, transtracheal block

Excessive doses of local anaesthetic should be avoided as this could result in systemic toxicity. A lignocaine plasma concentration of 5 mg.l^{-1} is considered toxic (49). The risk of toxicity is low if a total maximum dose of 3 to 4 mg.kg^{-1} of lignocaine is administered (6). The overall lignocaine dose should not exceed 7 mg.kg^{-1} (60). It is of note that nebulised lignocaine is more likely to be absorbed from the small bronchi thus increasing the plasma level (6).

A summary of selected literature pertaining airway anaesthesia for awake FOI is given Table 3.

Table 3: Airway anaesthesia for awake FOI

Author	Method	Conclusion
Kundra et al. (37)	Described the level of patient comfort and haemodynamic stability following airway nebulisation versus combined regional airway blocks.	Both techniques provided satisfactory upper airway anaesthesia. Based on a grimace score, airway reactivity score and haemodynamic parameters, patients receiving airway blocks were more stable and comfortable.
Larijani et al. (61)	Evaluated how safe and efficient EMLA cream is for anaesthetising the airway for awake FOI. (EMLA® cream is a eutectic mixture of local anaesthetics prilocaine 2.5% and lignocaine 2.5%)	EMLA® cream was a safe and effective alternative to anaesthetise the mouth and oropharynx for awake oral FOI. Plasma levels of the drugs did not reach toxic levels and methaemoglobin levels did not exceed normal parameters. The cream appeared to be palatable and in none of the 20 subjects the rescue topicalisation protocol had to be applied.
Williams et al. (49)	Used nebulised lignocaine to make the subsequent topical application of local anaesthetic by the spray-as-you-go method more tolerable.	All of the 25 non-sedated volunteers undergoing awake FOI reported the experience as acceptable.

Author	Method	Conclusion
Ji et al. (50)	Investigated the efficacy of endotracheal administration of sufentanil and tetracaine through the cricothyroid membrane for awake FOI in order to reduce the risk of adverse effects of local anaesthetic drugs.	The authors concluded that this was a safe and effective alternative regimen.
Gupta et al. (23)	Compared ultrasonic nebulisation with 10 ml 4% lignocaine to the administration of bilateral superior laryngeal nerve blocks and transtracheal administration of lignocaine in combination with gargling with lignocaine.	In a study of 50 patients with cervical spine injury undergoing awake FOI the quality of airway anaesthesia was superior with airway blocks as opposed to nebulization with lignocaine. Patient comfort levels were higher and intubation was generally easier following the airway blocks.
Ovassapian A. (48)	Recommended lignocaine 4% applied to nasal mucosa with soaked swabs as well as gargling with lignocaine and the administration of a transtracheal block.	This technique is taught in the Wits Department of Anaesthesiology and is referred to as the Ovassapian technique.

1.6 Technique

FOI entails passing an endotracheal tube between the vocal cords by railroading the tube over a flexible bronchoscope that continuously provides an image of the airway (28). Successfully executing an awake FOI strongly depends on the appropriate preparation of the equipment and the patient (6, 28). The patient has to remain as comfortable and haemodynamically stable as possible (27). Particular consideration should be given to the pre-operative assessment, explaining to the patient what lies ahead, preparation of the equipment, sedation

as well as application of a local anaesthetic to the airways, as previously described (28). The patient should be provided with supplemental oxygen (6).

The anaesthetist should be standing on a stool to prevent the FB from kinking (6) and to allow the anaesthetist to hold the insertion cord at the tip for accurate manipulation (28). The anaesthetist may choose to stand at the head of the patient as for conventional laryngoscopy as this will preserve the orientation with regards to the airway anatomy. When performing an orotracheal FOI the anaesthetist might feel more comfortable standing beside the patient, facing the head, which results in an inverted view of the airway. This may be confusing especially for the beginner (6). Facing the patient however allows the anaesthetist to observe the monitors as well as have eye contact with the patient (62).

Ensure that the endotracheal tube (ETT) slides easily across the shaft of the FB (6). This can be made easier by applying saline or distilled water to facilitate the withdrawal of the FB from the ETT (63). A reinforced ETT is preferred as it is more flexible and passes through the nose more easily (6). According to Brull et al. (64), the use of a flexible silicone tube resulted in less laryngeal trauma when compared to a polyvinyl tube as it advanced more easily over the FB. Completely deflate the cuff of the ETT and liberally apply a lubricant over it (6). Avoid lubricating the distal 20 cm of the insertion cord to allow better grip when moving this part by hand (28). The insertion cord must be held with only two fingers to prevent unequal pressure points and breakage of the fibres (32).

Both oral and nasal approaches can be followed. Nasal intubation is considered superior because the vocal cords are more easily visualised since the FB is less obstructed by the tongue. The nasal approach avoids difficulties associated with limited mouth opening and allows for an unobstructed surgical field during maxillofacial and ear-, nose- and throat procedures (5). A nasal intubation is more tolerable for the patient and allows for the tip of the FB to be guided by the anatomy of the nasopharynx towards the glottis (2). The wider nostril should be used for instrumentation. The ETT can be used as a guide for the FB or the ETT can be mounted onto the scope and advanced through the nose once the trachea has been identified with the scope. Care should be taken to prevent the FB from slipping through the Murphy eye (6).

In the case of an oral FOI, an intubating airway may be required to facilitate intubation. Bite blocks protect the FB from the teeth. Intubating airways and a laryngoscope blade can be used to displace the tongue and maintain the scope in the midline (5). Currently available intubating airways include the Ovassapian fibreoptic intubating airway, Williams airway intubator and the Berman intubating airway (65). When using the oral approach, the tip

of the scope should be tilted 45 degrees towards the oropharynx prior to introducing the scope into the patient's mouth (5).

A standard FB is ergonomically designed to be held by the right hand while the left hand controls the distal end. Avoid bending the insertion cord (25). Insert the FB with the tip directed towards the glottis. Use the angulations control lever, operated by the thumb, to steer the tip of the scope towards the vocal cords (5). Identify familiar anatomical structures by carefully advancing the FB under visual control. Slowly withdraw the FB if the view or orientation is lost (6).

The first landmark is the epiglottis which should become visible once the turbinate is passed. Next, identify the laryngeal opening located underneath the epiglottis. Warn the patient about the airway irritation that will follow and then spray the vocal cords with lignocaine once they become visible. Allow 2 to 3 minutes for it to take effect in order to avoid coughing and laryngospasm. The FB is then advanced further past the vocal cords into the trachea as evidenced by the view of the tracheal cartilage rings. The carina is usually visible at this point. A second dose of lignocaine should be sprayed onto the tracheal mucosa. After waiting another two to three minutes, railroad the ETT into the trachea while continuously visualising the tracheal rings to prevent the tube from accidentally dislodging into the oesophagus or oropharynx (6). The optimal position for the ETT in an adult is two to three centimetres above the carina (5).

As the diameter of the FB is smaller than that of the ETT, the bevel of the ETT may get wedged onto arytenoid cartilage (6). If resistance is encountered distal to the pharynx it is mostly either at the epiglottis or the right sided arytenoid (66). If this occurs, slightly withdraw the ETT, rotate it counter-clockwise for 45 to 90 degrees and gently re-advance (6, 66). Improving the size matching between the ETT and the FB will reduce the risk of entrapment of the leading edge of the ETT in the glottic structures. FOI may further be facilitated by performing a jaw thrust or by instructing the patient to protrude the tongue (5).

Once the FB has been withdrawn from the ETT, verify its placement and secure. General anaesthesia should then be induced with a rapidly acting intravenous agent (6).

1.7 Advantages

FOI is a safe and effective technique. The airway can be evaluated prior to placement of the ETT. FOI can be performed on a patient in any position. It is associated with fewer cardiovascular responses than conventional laryngoscopy (6).

1.8 Limitations and complications

Even though prices have dropped, the major disadvantage of the FB remains the high cost. Extra time is needed to prepare for an awake FOI (67). It is a time consuming procedure and requires a high level of skill (6).

Complications include local anaesthetic toxicity, laryngospasm, endobronchial intubation, trauma to local structures resulting in epistaxis and dislocation of an arytenoid leading to a sore throat, change in voice, odynophagia, stridor and dyspnoea (6). FOI may also bring about hypoxaemia and aspiration (5). Perforation of the oesophagus and barotrauma are rare but serious complications (68).

1.9 Current practice guidelines

The ASA guidelines list awake intubation as a planned, non-invasive strategy to manage the difficult airway (4). These guidelines do not include a stepwise approach to awake FOI as such but the ASA published “tips from the ASA workshop” that provided details on each step of awake FOI (16). Heidegger (69) commented that the updated Difficult Airway Society guidelines (70) should include guidelines for the anticipated difficult airway to become “truly revolutionary”.

The South African Society of Anaesthesiologists adopted the ASA difficult airway algorithm but also does not include a specific approach to awake FOI (71).

Lema et al. (32) developed a step by step method that is applied in the anaesthesia department of the Valle University Hospital in Columbia based on the literature, group discussions and personal experience.

1.10 Teaching and training

The process of awake FOI is not clearly defined in most scenarios. Personal preference mainly dictates the methods applied when performing this procedure (72). FOI should however be conducted in an organised, standardised fashion (73) as the quality of the process of FOI relates to the quality of the overall procedure (72). Improper sedation is a recognised factor leading to failure of FOI (14) despite many different drugs and drug combinations having been applied over the past 30 years (38). It has been shown that adherence to a recommended predetermined algorithm, resulted in an 85% success rate with the first attempt (72). Following a guideline or protocol prevents the anaesthetist from improvising and increases the likelihood of success irrespective of the operator’s expertise in FOI (32).

To master FOI, the anaesthetist has to develop and execute an intricate set of psychomotor and judgement skills (74). The anaesthetist must be familiar with the FB and be able to skilfully manipulate it during the procedure (75). It appears however that FOI skills are not taught on a routine basis (74) and trainees feel inadequately taught in this domain (15). According to the NAP4, being inexperienced with awake FOI and unfamiliar with

the equipment, resulted in avoidance of its application even when indicated (14). Slavkovic et al. (25) came to the same conclusion and stated that anaesthetists were insufficiently trained in FOI. Exclusive “on the job experiential learning” could produce anaesthetists that are not proficient in FOI (15). A formal teaching program in FOI may be required to promote skills development and ensure proficiency in this technique (76).

Enhancing the FOI skills of the anaesthetist improves airway management while ensuring patient safety. This results in a lower incidence of airway injuries and aspiration, shorter intubation time, a reduced number of attempts and fewer surgical airways (74). FOI should not be dreaded (16) but be practiced on a routine basis on normal airways rather than only in the emergency situation or on difficult airways (6, 77, 78).

It is unclear what exactly constitutes proficiency in awake FOI (79). Smith et al. (80) suggested that 45 FOIs need to be performed in order for an anaesthetist to gain true expertise. According to Pott et al. (81), 46% of program directors in the United States and Canada believed that up to 39 supervised awake FOIs and up to 59 intubations in total (awake and asleep) with the flexible FB have to be performed to gain competency.

According to Johnson et al. (82), competency is obtained after a trainee has successfully intubated the airway of a patient under general anaesthesia at least 10 times with a single attempt in under two minutes.

Anaesthetic trainees in the United Kingdom perform on average less than 10 FOIs before becoming consultants (75). In their study conducted in New Zealand, Dawson et al. (76) concluded that the majority of anaesthetists do perform FOI but the frequency may not be adequate to continuously develop and preserve this skill.

The “see one, do one” training method has existed in medicine for a long time but the advantages of a graduated teaching program are now generally recognised (15). Smith et al. (80) concurred that the skill of FOI is best attained by formal training programmes rather than relying on incidental learning. According to Collins et al. (5), no superior method of teaching has been agreed upon with regards to FOI. Ovassapian et al. (77) stated that various learning methods for FOI should be incorporated into a stepwise program including attempts on a model followed by identifying the epiglottis with the FB in recovering patients. Finally the trainee would perform an awake FOI on a sedated patient. This program received overwhelmingly positive feedback (77). According to Bray et al. (83) the most effective approach was training in the department by experienced teachers. A familiar environment and low trainee to trainer ratio were beneficial but it may not be ethically correct to expose the patient to a novice (83).

Didactic teaching cannot replace practical training but provides essential knowledge by means of tutorials and lectures (84). The complex motor skills required to perform FOI can be practiced on a bench model before applying it to a patient (15). The model may be useful in both introducing the technique to the trainee as well as

improving essential fibreoptic handling skills (5). Naik et al. (85) found that anaesthesia residents who had trained on a bench model prior to transferring their skills onto patients, performed better as compared to those trainees who only received classroom teaching. Examples of bench models include the “hit the hole” device and the “Oxford fibreoptic teaching box” (15).

After conducting a FOI workshop utilising manikins, Dykes et al. (86) found an increased success rate in FOI and that this technique could be incorporated in the practice of 35% of the participants that completed the course. A computerised manikin had been developed that simulated different difficult airway situations thereby allowing a training experience that more closely resembled reality (15).

Closed circuit television has significantly improved acquiring of the skill of nasotracheal FOI. This useful tool allows the teacher and the trainee to simultaneously view the intubation. The instructor can thereby demonstrate the technique and provide guidance while the trainee is performing the procedure (15). “Virtual simulation” provides the most accurate imitation of a lifelike clinical setting (5). By practising with a simulator first, time to intubate with the FB is reduced (87) and psychomotor skills are improved (88).

It is understandable that the anaesthetist may be reluctant to perform an awake FOI on a patient after training on a manikin (15). Ovassapian et al. (77) however emphasise the importance of learning on an awake patient.

Possible sources of awake subjects include the bronchoscopy clinic and the participants of training courses in awake FOI (15). Woodall et al. (89) reported that 200 healthy, “self-selected” anaesthetists voluntarily underwent awake FOI without sedation as part of a training course at the Norfolk and Norwich University Hospital over a nine year period. Further assessment of this approach is however required in view of the associated adverse events (89).

Practising on a recently demised patient is ethically questionable. Considering the number of alternative opportunities for the anaesthetist, this is unnecessary. (15) The anatomy of a cat (90) and a pig (91) is considerably analogous to that of a human but practising on anaesthetised animals may not be practical and also introduces ethical challenges (15).

Barriers to gaining this skill of awake FOI include lack of teachers (15), lack of clinical cases (76) and pressure in theatre for quick turnover of cases (11, 83).

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Section 2: Journal's author guidelines

This section contains the guidelines which the author has followed with regards to the formatting and length of the research article. The guidelines followed were those of the South African Journal of Anaesthesia and Analgesia which is the intended journal of publication.

Aims, scope and review policy

The SA Journal of Anaesthesia and Analgesia aims to publish original research and review articles of relevance and interest to the anaesthetist in academia, public sector and private practice. Papers are peer reviewed to ensure that the contents are understandable, valid, important, interesting and enjoyed. All manuscripts must be submitted online.

SAJAA is accredited by the Department of Education for the measurement of research output of public higher institutions of South Africa (SAPSE accredited). All articles in SAJAA will be peer reviewed.

Article sections and length

The following contributions are accepted (word counts exclude abstracts, tables and references):

- * Original research (2800 – 3200 words/ 4-5 pages)
- * Clinical Reviews (2400 words/ 3-4 pages)
- * Drug Reviews (2400 words/ 3-4 pages)
- * Case Studies (1800 words/ 3 pages)
- * Scientific Letters (2400 words/ 3-4 pages)
- * Letters to the Editor (400-800words]

Please see the journal's section policies section policies for further details.

Title page

All articles must have a title page with the following information and in this particular order: Title of the article; surname, initials, qualifications and affiliation of each author; The name, postal address, e-mail address and telephonic contact details of the corresponding author and at least 5 keywords.

Abstract

All articles should include an abstract. The structured abstract for an Original Research article should be between 200 and 230 words and should consist of four paragraphs labelled Background, Methods, Results, and Conclusions. It should briefly describe the problem or issue being addressed in the study, how the study was

performed, the major results, and what the authors conclude from these results. The abstracts for other types of articles should be no longer than 230 words and need not follow the structured abstract format.

Keywords

All articles should include keywords. Up to five words or short phrases should be used. Use terms from the Medical Subject Headings (MeSH) of Index Medicus when available and appropriate. Key words are used to index the article and may be published with the abstract.

Acknowledgements

In a separate section, acknowledge any financial support received or possible conflict of interest. This section may also be used to acknowledge substantial contributions to the research or preparation of the manuscript made by persons other than the authors.

References

Cite references in numerical order in the text, in superscript format (Format> Font> Click superscript). Please do not use brackets or do not use the foot note function of MS Word.

In the References section, references must be typed double-spaced and numbered consecutively in the order in which they are cited, not alphabetically.

The style for references should follow the format set forth in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (<http://www.icmje.org>) prepared by the International Committee of Medical Journal Editors. Abbreviations for journal titles should follow Index Medicus format. Authors are responsible for the accuracy of all references. Personal communications and unpublished data should not be referenced. If essential, such material should be incorporated in the appropriate place in the text.

List all authors when there are six or fewer; when there are seven or more, list the first three, then ";et al.";

When citing URLs to web documents, place in the reference list, and use the following format: Authors of document (if available). Title of document (if available). URL. (Accessed [date]).

The following are sample references:

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<http://www.journals.uchicago.edu/ICHE/journal/issues/v27n1/2004069/2004069.web.pdf>.

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Section 3: Draft article

Title

Anaesthetist's practice of awake fiberoptic intubation in adult patients

Authors

Van Rooy, E. (BPharm, MBBCh, DA)

Perrie, H. (MSc)

Scribante, J. (M Cur)

Milner, A. (MBBCh, FCA, FRCP, MMed)

Department of Anaesthesiology, School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand

Corresponding author

Elizabeth van Rooy

Department of Anaesthesiology

Rahima Moosa Mother and Child Hospital

37 Pixley Ka Isaka Seme Street, Marshalltown, Johannesburg

+27 11 355 3000

elizevr@gmail.com

Keywords

Awake fiberoptic intubation, adults, sedation, topicalisation, training

Abstract

Background

Awake fiberoptic intubation (FOI) remains the gold standard management of the anticipated difficult airway. An organised approach will ensure success and patient comfort. Training has to be rigorous to instil confidence. Exposure, practice and level of confidence of awake FOI in the Department of Anaesthesiology at the University of the Witwatersrand (Wits), is not known.

Methods

Anaesthetists were surveyed with an anonymous self-administered questionnaire. A total of 130 questionnaires were distributed at departmental academic meetings over five months and 126 (96.9%) questionnaires were returned.

Results

The majority (41.2%) had only performed one to five awake FOIs, 12.7% had performed 21 to 50, but 13.5% had never performed any. The majority were trained on asleep (39.8%) and awake (31.9%) patients. Only 20.4% had manikin, and 4.2% simulator training. While 58.7% had reasonable levels of confidence, 41.3% had low confidence. Midazolam (35.0%) and fentanyl (26.7%) were the most commonly used drugs for sedation followed by remifentanyl (16.1%) and dexmedetomidine (12.2%). All topicalised the airway prior to awake FOI. Lignocaine 2% was the drug of choice (72.2%). Techniques included application of soaked swabs (23.4%), spray (22.8%), spray-as-you-go (18.7%), nebulisation (16.4%), gel or ointment (8.8%), transtracheal block (6.4%) and gargle (2.9%).

Conclusion

Anaesthetists in the Wits Department may not be adequately exposed to awake FOI and demonstrated a marked variability in sedation and topicalisation practices.

Introduction

The inappropriate management of a difficult airway is the most common anaesthetic cause of morbidity and mortality.¹ According to the American Society of Closed Claim Analysis, respiratory complications were responsible for 37% of anaesthetic adverse events. Of these, 72% were considered preventable. Difficult tracheal intubation rated amongst the most common causes of brain damage and death.² It is critical that the anaesthetist is familiar with the mechanisms responsible for predicting a difficult intubation and knows how to manage these challenges.³ Awake FOI remains the gold standard for the management of an anticipated difficult airway in a spontaneously breathing patient⁴⁻⁶ despite claims that recent airway advances may supersede the fiberoptic bronchoscope (FB).^{7, 8} Failing to use FOI when indicated could result in airway complications and jeopardise patient safety.⁹

To master FOI, the anaesthetist has to develop an intricate set of psychomotor and judgement skills.¹⁰ The anaesthetist must be familiar with the FB and be able to skilfully manipulate it during the endoscopy.¹¹ It appears however that FOI skills are not taught on a routine basis¹⁰ and trainees feel inadequately taught in this domain.⁹ Even though FOI was considered a core skill amongst anaesthetists in a United Kingdom based survey, McNarry et al.¹¹ found that trainees did not meet the target number of intubations thought to deem them competent. Kristensen et al.¹² found the majority of anaesthesiologists in a Danish study had no or little experience in performing FOI despite having adequate access to the FB.

Lacking experience and being unfamiliar with awake FOI may result in avoidance of the procedure altogether.¹³ The Fourth National Audit Project of the Royal College of Anaesthetists indicated that FOI was underutilised in managing difficult airways, possibly due to a lack of confidence to perform awake FOI.¹⁴ Kluger et al.¹⁵ concurred that anaesthetists were hesitant to perform awake FOI based on the results of the Australian Incident Monitoring Study. Factors that may limit the development of this skill include small numbers of clinical cases¹⁶, pressure in theatre for quick turnover¹⁷, fear of failing and equipment being unavailable.¹⁸

Exclusive “on the job experiential learning” could produce anaesthetists that are not proficient in FOI.⁹ The “see one, do one” training method has existed in medicine for a long time but the advantages of a graduated teaching program are now generally recognised.¹⁹ A formal teaching program in FOI may be required to promote skills development and learning.¹⁶

Successfully executing an awake FOI strongly depends on the appropriate preparation of the equipment and the patient.^{5, 20} The patient has to remain as comfortable and haemodynamically stable as possible.²¹ Particular consideration should be given to the pre-operative assessment, explaining to the patient what lies ahead,

preparation of the equipment, sedation as well as application of a local anaesthetic to the airways.²⁰ The process of awake FOI is not clearly defined in most scenarios. Personal preference mainly dictates the methods applied when performing this procedure²² but awake FOI should be conducted in an organised fashion.²³ Adherence to a recommended predetermined algorithm resulted in an 85% success rate with the first attempt.²² Including FOI as an essential element in a departmental intubation algorithm resulted in a negligible FOI failure rate.²⁴

Method

Approval to conduct the study was obtained from the Human Research Ethics Committee (Medical) and the Graduate Studies Committee of Wits. A convenience sampling method was used by means of an anonymous self-administered questionnaire. A prospective, contextual, descriptive research design was followed. The study population consisted of the anaesthetists working in the Wits Department of Anaesthesiology.

A total of 130 questionnaires were handed out at departmental academic meetings over a period of five months and 126 (96.9%) questionnaires were returned. This represents 58% of the anaesthetists in the department.

Data was entered into a Microsoft Excel® spreadsheet and analysed using frequencies and percentages.

To determine if there was a significant relationship between level of confidence (very low and low or average, high and very high) between junior and senior anaesthetists, we employed a Chi² test for independence.

Results

The demographic information of the participants is shown in Table I including gender, age, professional designation and years of experience in anaesthesia.

Table I: Demographic data

Demographic	n (%)
n = 126	
Gender	
Female	81 (64.2)
Male	45 (35.8)
Age	
25-30 Years	25 (19.8)
31-35 Years	67 (53.2)
36-40 Years	15 (11.9)
41-45 Years	9 (7.1)
46-50 Years	5 (4.0)
>50 years	5 (4.0)
Professional designation	
Medical officer	10 (7.9)
Registrar – 1st, 2nd, 3rd year	43 (34.1)
Registrar – 4th year	21 (16.7)
Career medical officer/Consultant	51 (40.5)
Missing data	1 (0.8)
Years of experience in anaesthesia	
≤5 Years	55 (43.6)
>5 Years	67 (53.2)
Missing data	4 (3.2)

The number of awake FOIs performed by the participants as well as the approximate frequency of performing awake FOI is shown in Table II. The 17 (13.4%) participants who had never performed awake FOI were not included in the frequency. These participants were instructed not to fill in the remainder of the questionnaire.

Table II: Number of awake FOIs performed and frequency of performing awake FOI

FOIs	n (%)
n = 126	
Number of awake FOIs performed	
Nil	17 (13.5)
1-5	52 (41.2)
6-10	20 (15.9)
11-20	16 (12.7)
21-50	16 (12.7)
>50	3 (2.4)
Missing data	2 (1.6)
Frequency	
Almost never	3 (2.7)
Daily	0 (0.0)
Weekly	3 (2.7)
Monthly	25 (23.0)
Annually	49 (45.0)
Other	27 (24.8)
Missing data	2 (1.8)

Participants who selected “other” specified that they would perform awake FOI only when a difficult airway was anticipated.

The training methods utilised by anaesthetists to perform awake FOI as well as the combinations of training methods selected by participants are shown in Table III. Participants could select more than one option.

Table III: Methods for training to perform awake FOI

Training method	n (%)
Nil	3 (1.4)
Patient asleep	86 (39.8)
Patient awake	69 (31.9)
Manikin	44 (20.4)
Simulator	9 (4.2)
Other	5 (2.3)
Combinations of training methods	
n = 109	
Nil	3 (2.8)
Patient – awake	10 (9.2)
Patient – asleep	18 (16.5)
Manikin	3 (2.7)
Patient - asleep, Patient – awake	27 (24.8)
Manikin, Patient – asleep	13 (11.9)
Manikin, Patient – awake	3 (2.8)
Manikin, Patient - asleep, Patient - awake	20 (18.3)
Simulator, Patient – awake	1 (0.9)
Simulator, Patient – asleep	1 (0.9)
Simulator, Patient - asleep, Patient – awake	2 (1.8)
Manikin, Simulator, Patient – awake	1 (0.9)
Manikin, Simulator, Patient - asleep, Patient – awake	3 (2.8)
Manikin, Simulator, Patient - asleep, Patient - awake, Other - Airway courses	1 (0.9)

Patient - awake, Other – Observation only	1 (0.9)
Patient - asleep, Other – Self training, Other - YouTube	1 (0.9)
Other - Self training	1 (0.9)

Participants who selected “other” specified that they trained by observing awake FOI, attending airway workshops and self-training by watching educational material on YouTube® or studying the literature (two participants).

The self-perceived level of confidence of anaesthetists when performing awake FOI is shown in Table IV.

Table IV: Level of confidence when performing awake FOI

Level of confidence	n (%)
n = 109	
Very low	19 (17.4)
Low	26 (23.9)
Average	43 (39.4)
High	15 (13.8)
Very high	6 (5.5)

The factors that contributed to the anaesthetist’s proficiency in awake FOI are shown in Table V. The total column reflects the number of participants who completed the particular question.

Table V: Factors contributing to proficiency in awake FOI

Factor	Strongly disagree	Disagree	Agree	Strongly agree	Total
	n (%)	n (%)	n (%)	n (%)	n
Equipment availability	1 (1)	9 (8.6)	36 (34.3)	59 (56.2)	105
Equipment functionality	1 (1)	6 (5.8)	42 (40.4)	55 (52.9)	104
Number of cases available	2 (1.9)	13 (12.6)	50 (48.5)	38 (36.9)	103
Practicing on normal airways	5 (4.8)	14 (13.5)	47 (45.2)	38 (36.5)	104
Airway workshops	5 (4.8)	15 (14.4)	63 (60.6)	21 (20.2)	104
Time available	2 (1.9)	18 (17.1)	60 (57.1)	25 (23.8)	105
Availability of a FOI algorithm	8 (7.8)	36 (35)	43 (41.7)	16 (15.5)	103

In Table VI the position of the anaesthetist relative to the patient as well as the anaesthetist's preferred approach are shown. One participant specified that positioning would depend on the clinical scenario.

Table VI: Positioning of the anaesthetist when performing awake FOI and the preferred approach

Positioning and approach	n (%)
n = 109	
Positioning	
Facing the patient	23 (21.1)
Behind the patient	40 (36.7)
Elevated	7 (6.4)
Facing the patient, Elevated,	7 (6.4)
Behind the patient, Elevated,	18 (16.5)
Facing the patient, Same level as the patient,	4 (3.7)
Facing the patient, Behind the patient,	4 (3.7)
Elevated, Other – Depends	1 (0.9)
Facing the patient, Behind the patient, Elevated	2 (1.8)
Behind the patient, Same level as the patient,	1 (0.9)
Facing the patient, Behind the patient, Same level as the patient	1 (0.9)
Missing data	1 (0.9)

Preferred approach	
Nasal	98 (89.9)
Oral	6 (5.5)
Other	2 (1.8)
Missing data	3 (2.8)

Administration of an antisialogogue as a premedication was indicated by 80 (73.4%) participants.

Glycopyrrolate was the most commonly administered premedication by 76 (95.0%) participants, while two (2.5%) of the participants selected either glycopyrrolate or atropine. All but one (1.3%) of the participants administered glycopyrrolate intravenously and the most commonly administered dose was 0.2 to 0.4 mg by 55 (79.7%) participants.

Sedation was administered by 86 (78.8%) participants and three (2.7%) participants indicated that administration of sedation would depend on the clinical scenario. The most commonly used technique for sedation was titrated boluses by 68 (71.65%) participants followed by administration of an infusion by 16 (16.8%) participants and target controlled infusion by six (6.3%) participants. The most frequently used drug for sedation was midazolam given by 63 (35.0%) participants followed by fentanyl by 48 (26.7%) participants, remifentanyl by 26 (16.1%) participants and dexmedetomidine by 22 (12.2%) participants.

All the participants indicated that they topicalised the airway with a local anaesthetic prior to awake FOI.

Multiple options could be selected with regards to techniques of topicalisation. The most frequently selected techniques are shown in Table VII.

Table VII: Techniques for topicalisation

Technique	n (%)
Apply soaked swaps	80 (23.4)
Spray	78 (22.8)
Spray-as-you-go	64 (18.7)
Nebulise	56 (16.4)
Apply gel or ointment	30 (8.8)
Transtracheal block	22 (6.4)
Gargle	10 (2.9)

A transtracheal block was not listed as an option but participants specified this block in “other”. Lignocaine 2% was the preferred local anaesthetic by 104 (72.2%) participants followed by lignocaine 10% selected by 26 (18.1%) participants. Phenylephrine was applied to the airway by five (3.5%) participants even though this was not listed as an option.

There was a statistically significant difference in the level of confidence of junior and senior anaesthetists with senior anaesthetists being more confident than junior anaesthetists [$\chi^2(1) = 40.58$, $p\text{-value} < 0.01\%$].

Discussion

Different authors have conflicting ideas of what exactly constitutes proficiency of awake FOI. According to Pott et al.²⁵, 46% of program directors in North America believed that up to 39 supervised awake FOIs and up to 59 intubations in total (awake and asleep) with the FB have to be performed to gain competency. Smith et al.²⁶ suggested that 45 FOIs must be performed in order for an anaesthetist to gain true expertise. Johnson et al.²⁷ stated that competency in FOI was obtained after a trainee has successfully intubated the airway of a patient under general anaesthesia with the FB at least 10 times with a single attempt in under two minutes. In our study, 12.7% of the participants performed between 21 and 50 awake FOIs, thus complying with the literature, while 41.2% performed one to five awake FOIs and 13.5% had never performed awake FOI in their career. It is possible that the majority of the participants in our study had not performed sufficient numbers of awake FOIs to become proficient in this skill. Similar results had been found in the United Kingdom where anaesthetic trainees performed on average less than 10 FOIs before becoming consultants¹¹ as well as New Zealand where the majority of anaesthetists did not perform the adequate numbers of FOIs required to continuously develop and preserve this skill.¹⁶ An estimated 25 FOIs had been performed by 34% of North American anaesthesiology residents by the time they graduate.²⁵

Awake FOI was performed approximately once a year by 45.0% of participants, while 24.8% performed awake FOI only when facing a difficult airway. FOI should be practiced on a routine basis on normal airways rather than only in the emergency situation or on difficult airways.^{5, 28, 29} The FB is however a delicate instrument³⁰ and its maintenance has financial implications resulting in everyday FOIs being discouraged in our setting.

In our study participants were mostly being trained on either an asleep (39.8%) or awake (31.9%) patient. Even though manikins were available in the Wits Department of Anaesthesiology and at the annual airway workshop, only 20.4% of participants trained on a manikin. Participants overall had little exposure to training on a simulator (4.2%). According to Collins et al.⁴, no superior method of teaching had been agreed upon with regards to FOI but Dykes et al.³¹ found that the success rate increased in awake FOI after participants completed

a workshop that utilized manikins. In addition, awake FOI could be incorporated in the practice of 35% of the participants that completed the course³¹ based on feedback provided by the attendants by means of a questionnaire. By practising with a simulator first, time to intubate with the FB was reduced³² and psychomotor skills were improved.³³ Ovassapian et al.²⁸ advocated stepwise teaching which incorporated various learning methods for awake FOI including attempts on a model followed by identifying the epiglottis in recovering patients and finally performing an awake FOI in a sedated patient. The participants in our study had not been readily exposed to the various FOI training devices.

While 58.7% of the participants had an average, high or very high level of confidence when performing awake FOI, 41.3% of participants had low or very low confidence. According to the Fourth National Audit Project of the Royal College of Anaesthetists, a lack of confidence to perform awake FOI may explain why FOI was underutilised in managing difficult airways in the United Kingdom.¹⁴

Raveendra¹⁰ stated that the lack of availability of the FB resulted in FOI not being taught routinely in India. In our study however, 90.5% of participants agreed or strongly agreed that equipment for awake FOI was readily available. Equipment was also functional according to 93.3% of participants. Proficiency in awake FOI was not being limited by the number of cases available as indicated by 88 (85.4%) participants. This differs from the findings of Dawson et al.¹⁶ who identified a lack of clinical cases in New Zealand as a barrier to developing this skill. Practising on normal airways had been agreed or strongly agreed upon by 81.7% of participants in our study as a factor that positively contributed towards their skill in awake FOI. Exposure to airway workshops made anaesthetists more proficient in FOI as indicated by 80.8% of participants which concurs with Rosenblatt et al.³⁴ who stated that anaesthetists who attend airway workshops were more likely to utilise the FB. Time constraints did not have a negative impact on their learning of FOI as indicated by 81.0% of participants. Bray et al.¹⁷ and Fitzgerald et al.¹⁸ identified the pressure in theatre for quick turnover of cases as a factor that may prevent adequate opportunity for awake FOI, but in our study participants mostly agreed or strongly agreed this was not the case. Even though 42.7% of participants did not agree, 57.3% of participants indicated that the availability of an algorithm positively influenced their proficiency in awake FOI. This concurs with the recommendation of Heidegger et al.²² that adherence to a recommended predetermined algorithm, resulted in an 85% success rate with the first intubation attempt.

Participants generally positioned themselves behind the patient. Standing beside the patient, facing the head, resulted in an inverted view of the airway which might be confusing especially for the beginner.⁵ The overwhelming majority (89.9%) of the participants usually used the nasal approach. Collins et al.⁴ explained that

both the oral and nasal approaches could be followed. Nasal intubation was considered superior because the vocal cords were more easily visualised due to the FB being less obstructed by the tongue. The nasal approach avoided difficulties associated with limited mouth opening and allowed for an unobstructed surgical field during maxillofacial and ear-, nose- and throat procedures.⁴ A nasal intubation was more tolerable for the patient and allowed for the tip of the FB to be guided by the anatomy of the nasopharynx towards the glottis.¹

Glycopyrrolate was administered as an antisialogogue by 95% of participants demonstrating a uniform practice with regards to premedication. According to Collins et al.⁴, glycopyrrolate was the drug of choice as it did not cause sedation and had a rapid onset of action. The recommended dose by Collins et al.⁴ was 0.1 to 0.2 mg. A higher dose was generally given in our study namely 0.2 to 0.4 mg which concurred with the recommendation of Slavkovic et al.¹⁹

Ideally, a patient undergoing awake FOI should be cooperative, comfortable, well analgised and maintain their own ventilation.³⁵ Over-sedation may result in apnoea and hypoxia. Inadequate sedation and analgesia may render the patient uncooperative.¹³ A variety of drug combinations to facilitate awake FOI had been described over the past 30 years, including propofol, benzodiazepines, opioids, ketamine and α -2-adrenoreceptor agonists. The practitioner had to select the ideal drug based on the particular patient and indication for awake FOI.³⁶ Unfortunately, appropriately designed randomised control trials demonstrating superiority of certain drug combinations are lacking.¹³

Our study showed a noticeable variation in sedation practises. Midazolam (35.0%) and fentanyl (26.7%) were the most commonly selected drugs followed by remifentanyl (16.1%) and dexmedetomidine (12.2%). The combination of midazolam and fentanyl was proposed by the founder of FOI, Ovassapian.³⁷ Walsh et al.²⁰ agreed that intravenous midazolam administered in small boluses was a popular choice because of its ability to provide sedation and anterograde amnesia. A short acting opioid such as fentanyl should be administered simultaneously to suppress coughing, depress laryngeal reflexes and offer analgesia.²⁰

Remifentanyl was used by 16.1% of participants. Puchner et al.³⁸ evaluated remifentanyl as a single drug for awake FOI and found that high doses of incremental remifentanyl improved the intubating conditions but patients were more likely to recall details of the procedure. This concurred with Leslie et al.¹³ who stated that remifentanyl could be effective as a single agent for sedation in awake FOI but because of the high occurrence of memory recall, additional agents may need to be administered. Adverse effects of remifentanyl include respiratory depression and bradycardia.³⁶

Dexmedetomidine was used by 12.2% of participants. According to Leslie et al.¹³ dexmedetomidine caused sedation, analgesia and anxiolysis, provided desirable amnesia and did not cause respiratory depression. Bergese et al.³⁹ found patients to be more calm and cooperative when dexmedetomidine was administered following premedication with midazolam as compared to repeated doses of midazolam only for conscious sedation during awake FOI. When Cattano et al.³⁵ compared remifentanyl and dexmedetomidine as anaesthetic agents for awake FOI, remifentanyl use resulted in a higher success rate with the initial attempt. Patients receiving dexmedetomidine were much slower to attain adequate levels of sedation but memory recall was lower in this group.³⁵ This concurred with the findings of Liu et al.⁴⁰ who stated that time to intubate was lower with remifentanyl as compared to dexmedetomidine because an adequate level of sedation was achieved significantly slower with dexmedetomidine. Dexmedetomidine has a linear pharmacokinetic profile⁴¹ and a loading dose of 0.7 to 1 $\mu\text{g.kg}^{-1}$ over 10 to 20 minutes should be administered for awake FOI.³⁶

Local anaesthetics should be applied to the airways to further decrease the discomfort of the intense airway stimulation brought on by awake FOI.⁴² All the participants in our study topicalised the airway prior to awake FOI. Lignocaine was the drug of choice (72.2%) and the preferred strength was 2%. Lignocaine 4% is not available in our setting but could be prepared by dilution of a 10% solution. Collins et al.⁴ and Koerner et al.⁵ concurred that lignocaine was the most commonly used drug as other local anaesthetic agents such as benzocaine and tetracaine have a narrow therapeutic window and are associated with methaemoglobinaemia. Ovassapian⁴³ however recommended a lignocaine 4% solution as this delivered satisfactory local anaesthesia with a low risk of toxicity, provided that a total dose of 3 to 4 mg.kg^{-1} was not exceeded.⁴³ Xue et al.⁴⁴ found no significant differences in the intubating conditions when lignocaine 2% was compared to 4% but lower plasma levels were found with a 2% solution. Lignocaine 10% was selected by 18.1% of participants but according to Woodall⁴⁵, a 10% solution should not be applied to the mucosa undiluted as this resulted in a stinging sensation. A vasoconstrictor such as phenylephrine was applied to the nasal mucosa by 3.5% of participants. This may not accurately reflect the practice of the department as it was not listed as an option in the questionnaire. Collins et al.⁴ and Fulling et al.⁴⁶ supported the application of lignocaine 2% plus phenylephrine 0.25% as a vasoconstrictor to prevent bleeding.

The preferred techniques for topicalisation were the application of soaked swabs (23.4%) followed by spray (22.8%), spray-as-you-go (18.7%), nebulise (16.4%), application of a gel or ointment (8.8%) and gargle (2.9%). A transtracheal block was performed by 6.4% of the participants. This number may not be fully representative as the transtracheal block was not listed as an option in the questionnaire but rather specified by participants as

“other”. Collins et al.⁴ stated that for a nasal intubation, the mucosa of the nose must be anaesthetised by directly applying soaked swabs, and the tongue, oropharynx and larynx could be anaesthetised by gargling or nebulising with lignocaine. Nebulised lignocaine was more likely to be absorbed from the small bronchi thus increasing systemic drug levels.⁵ Lema et al.⁴⁷ recommended spraying of lignocaine onto the base of the tongue and pharynx, gargling with lignocaine as well as the spray-as-you-go method which allowed anaesthesia of the vocal cords when they appear in the visual field.⁴⁷ Performing nerve blocks depends on physician experience and patient acceptability. The rapid onset and longer duration of action are definite advantages of airway blocks.⁴ According to Leslie et al.¹³, transtracheal lignocaine resulted in excellent anaesthesia of the airway. Koerner et al.⁵ preferred the spray-as-you-go technique to airway blocks as it was equally effective in suppressing airway reflexes in their experience, yet was less invasive. Lema et al.⁴⁷ discouraged blocking of the glossopharyngeal nerve by needle infiltration of the tonsillar pillars in view of the potential trauma to the carotid arteries and prolonged suppression of airway reflexes. Kundra et al.⁴⁸ however concluded that patients receiving combined regional airway blocks were more stable and comfortable during awake FOI compared to patients who only received local anaesthesia by nebulisation. Gupta et al.⁴⁹ concluded that bilateral superior laryngeal nerve blocks and a transtracheal block in combination with gargling was superior to nebulization with lignocaine judging by patient comfort levels and ease of intubation. Reasoner et al.⁵⁰ showed that the combination of nebulisation and a transtracheal block provided airway anaesthesia equal to bilateral glossopharyngeal- and superior laryngeal nerve blocks.

The process of awake FOI is not clearly defined in most scenarios. Personal preference mainly dictated the methods applied when performing this procedure.²² The traditional approach by Ovassapian³⁷ is taught in the Wits Department of Anaesthesiology, namely titrated boluses of fentanyl (to suppress airway reflexes) and midazolam (to prevent memory recall), application of lignocaine soaked swabs to the nasal mucosa as well as gargling with lignocaine and the administration of a transtracheal block.

Conclusion

Anaesthetists in the Wits Department of Anaesthesiology may not be adequately exposed to awake FOI and demonstrated a marked variability in sedation and topicalisation practices. A standard operating procedure for the process of awake FOI could be developed which may ultimately optimise patient care as anaesthetists in this study lacked confidence and experience with the procedure.

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Section 4: Appendices

Appendix 1: Post graduate approval



Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Ms Thokozile Nhlapo
E-mail: thokozile.nhlapo@wits.ac.za

10 February 2016
Person No: 0300157E
PAG

Dr E Van Rooy
Postnet Suit 376
private Bag X26
Sunninghill
2157
South Africa

Dear Dr Van Rooy

Master of Medicine: Approval of Title

We have pleasure in advising that your proposal entitled *Anaesthetists' practice of awake fiberoptic intubation in adult patients* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

A handwritten signature in cursive script, likely belonging to Mrs Sandra Benn.

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix 2: Ethics committee clearance certificate



R14/49 Dr Elizabeth van Rooy

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160104

NAME: Dr Elizabeth van Rooy

(Principal Investigator)

DEPARTMENT: Anaesthesiology

PROJECT TITLE: Anaesthetists' Practice of Awake Fiberoptic Intubation in Adult Patients

DATE CONSIDERED: 29/01/2015

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Helen Perrie

APPROVED BY:

A handwritten signature in black ink, appearing to read 'P Cleaton-Jones'.

Professor P Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 22/02/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004, 10th floor, Senate House/2nd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature

Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix 3: Turnitin report

Turnitin1.docx			
ORIGINALITY REPORT			
% 8	% 5	% 6	% 1
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
1	Koerner, I.P.. "Fiberoptic techniques", Best Practice & Research Clinical Anaesthesiology, 200512 Publication		% 1
2	rc.rcjournal.com Internet Source		<% 1
3	archive.org Internet Source		<% 1
4	He, Xing-Ying, Jian-Ping Cao, Qian He, Xue-Yin Shi, and Xue-Yin Shi. "Dexmedetomidine for the management of awake fibreoptic intubation", Cochrane Database of Systematic Reviews, 2014. Publication		<% 1
5	I. Calder. "Murphy P. A fibre-optic endoscope used for nasal intubation. Anaesthesia 1967; 22: 489-91 : Classic Paper", Anaesthesia, 11/2010 Publication		<% 1
6	Anesthesiology and Otolaryngology, 2013. Publication		<% 1

Section 5: Proposal

5.1 Introduction

The inappropriate management of a difficult airway is the most common anaesthetic cause of morbidity and mortality (1). Awake fiberoptic intubation (FOI) remains the gold standard for the management of an anticipated difficult airway in a spontaneously breathing patient (2, 3). FOI entails passing an endotracheal tube between the vocal cords by railroading the tube over a flexible bronchoscope that continuously provides an image of the airway (4).

One of the most important tasks of the anaesthetist is airway management. It is critical that the anaesthetist is familiar with the mechanisms responsible for predicting a difficult intubation and knows how to manage these challenges. (5) The anaesthetist should therefore be exposed to a wide range of techniques and equipment utilized in managing the difficult airway including that of FOI. In certain clinical scenarios, FOI may be the only possible way of securing a definitive airway. For example, the fiberoptic bronchoscope (FB) may be the only instrument suitable for intubating patients with severe trismus (6).

To master FOI, the anaesthetist has to develop and execute an intricate set of psychomotor and judgement skills (7). Sound knowledge of the airway anatomy is required. The anaesthetist must be familiar with the FB and be able to skilfully manipulate it during the endoscopy (8). It appears however that FOI skills are not taught on a routine basis (7) and trainees feel inadequately taught in this domain (9). Even though FOI was considered a core skill amongst anaesthetists in a United Kingdom based survey, McNarry et al. (8) found that trainees did not meet the target number of intubations thought to deem them competent. According to Kristensen et al. (10), the majority of anaesthesiologists in a Danish study had no or little experience in performing FOI despite having adequate access to the FB.

Small numbers of clinical cases and insufficient practise have been identified as factors limiting the development of this skill (11). As a result, anaesthetists do not feel confident to perform FOI. The Fourth National Audit Project of the Royal College of Anaesthetists indicated that FOI was underutilised in managing difficult airways, possibly due to a lack of confidence to perform the procedure (12). According to Kluger et al. (13), the Australian Incident Monitoring Study indicated that anaesthetists were hesitant to perform FOI. Failing to use FOI when indicated could result in airway complications and jeopardise patient safety (9).

Exclusive “on the job experiential learning” could produce anaesthetists that are not proficient in FOI (9). A formal teaching program in FOI may be required to promote skills development and learning (11).

Implementing training measures have resulted in an increase in the average number of FOI’s performed (14).

Smith et al. (15) illustrated that an average of 45 FOI's may need to be performed before a candidate can be considered competent.

Successfully executing an awake FOI strongly depends on the appropriate preparation of the equipment and the patient (3, 4). The patient has to remain as comfortable and haemodynamically stable as possible (16). Particular consideration should be given to the pre-operative assessment, explaining to the patient what lies ahead, preparation of the equipment, sedation as well as application of a local anaesthetic to the airways (4).

The process of awake FOI is not clearly defined in most scenarios. Personal preference mainly dictates the methods applied when performing this procedure. The quality of the process of FOI does however relate to the quality of the procedure (14). For example, over the past 30 years many different drugs and drug combinations have been applied (17), each with their own advantages and disadvantages. Competency in FOI is not necessarily reflected by the number of intubations performed but also depends on meeting the objectives of the intubation (9). FOI should therefore be conducted in an organised, standardised fashion (18). It has been shown that adherence to a recommended predetermined algorithm resulted in an 85% success rate with the first attempt (14). Including FOI as an essential element in a departmental intubation algorithm has also resulted in a negligible FOI failure rate (19).

5.2 Problem statement

As airway specialists, anaesthetists are required to skilfully manage the anticipated difficult airway. FOI is an indispensable tool for the anaesthetist to handle this clinical scenario (1). If FOI is not applied when indicated or is poorly executed, it could lead to devastating complications including cerebral hypoxia and death.

Anaesthetists should be trained to perform FOI and should regularly perform this procedure to remain confident and proficient (20). The literature suggests however that, despite its crucial role, FOI skills are not routinely taught during a training program (7), existing training opportunities are not adequate and trainees do not have the confidence to perform FOI (12).

Even though the process of FOI is influenced by personal preference, it is essential to evaluate the process of FOI and not only the result (14). In the awake patient that breathes spontaneously, meticulous attention has to be paid to sedation and analgesia to achieve a balance between good intubating conditions and patient comfort.

Over-sedation may result in apnoea and hypoxia. Inadequate sedation and analgesia may render the patient uncooperative (21). Both scenarios predispose the patient to morbidity despite being successfully intubated (14).

A marked difference in practice of FOI between anaesthetists may reflect a lack of structure in this process. An organised teaching program in FOI may be beneficial for anaesthesia trainees (21).

The exposure, level of confidence and practice of awake FOI in the Department of Anaesthesiology at the University of the Witwatersrand (Wits), is not known.

5.3 Aim

The aim of the study is to describe the practice of awake FOI in adult patients amongst anaesthetists working in the Department of Anaesthesiology at Wits.

5.4 Objectives

The primary objectives of the study are to:

- describe the exposure of anaesthetists to awake FOI
- describe the self-perceived level of confidence of anaesthetists in performing awake FOI
- describe the aspects that may contribute to proficiency in awake FOI
- describe the practice of awake FOI including preparation, sedation and technique.

The secondary objective of the study is to compare the level of confidence in performing awake FOI between junior and senior anaesthetists.

5.5 Research assumptions

The following definitions will be used in the study.

Anaesthetist: any qualified doctor working in the Department of Anaesthesiology including medical officers, registrars and consultants.

Medical officer: a qualified doctor practising in the Department of Anaesthesiology under specialist supervision. Medical officers with more than 10 years of experience as an anaesthetist are career medical officers and are regarded as consultants.

Registrar: a qualified doctor who is registered with the Health Professional Council of South Africa as a trainee anaesthetist.

Consultant: a doctor that has successfully completed all the College of Anaesthetists examinations, or equivalent, and meet all criteria required to become a specialist. Career medical officer are included in this group.

Junior anaesthetist: a medical officer or registrar with three or less years of training.

Senior anaesthetist: a fourth year registrar, consultant or career medical officer.

5.6 Demarcation of study field

The study will be conducted in the Department of Anaesthesiology, affiliated to the Faculty of Health Sciences at Wits. The department consists of 21 medical officers, 12 career medical officers, 112 registrars and 74 consultants.

The following hospitals are affiliated to the department.

- Charlotte Maxeke Johannesburg Academic Hospital, a central hospital with 1200 beds, 23 theatres and do 23 000 theatre cases per annum.
- Chris Hani Baragwanath Academic Hospital, a central hospital with 2888 beds, 25 theatres and do approximately 65 000 theatre cases per annum.
- Helen Joseph Hospital, a tertiary hospital with 500 beds, 7 theatres and do approximately 6000 theatre cases per annum.
- Rahima Moosa Mother and Child Hospital has 338 beds, 5 theatres and do approximately 6700 theatre cases per annum.

5.7 Ethical considerations

Approval to conduct the study will be obtained from the Human Research Ethics Committee (Medical) and the Postgraduate Committee of the University of the Witwatersrand.

The study will be a survey using an anonymous self-administered questionnaire (Appendix 1). Those agreeing to participate in the study will be given an information letter (Appendix 2) outlining the purpose of the study and what will be required of them. Completion of the questionnaire will be voluntary and consent will be implied by returning the questionnaire.

Questionnaires will contain no identifying data and will be returned into a sealed box marked “returned questionnaires”. Only the researcher and the supervisors will have access to the raw data. These measures will ensure anonymity and confidentiality.

Data obtained will be stored securely for six years after completion of study.

Should it be found that the anaesthetists are not confident to perform FOI and the FOI practice of the department is not optimal, the Head of Department will be notified with a view to instituting teaching programs.

The study will be conducted according to the principles of the Declaration of Helsinki (22) and the South African Guidelines for Good Clinical Practice (23).

5.8 Data collection

5.8.1 Research design

A prospective, contextual, descriptive research design will be followed in this study.

In a prospective study, an outcome is observed after following a certain population for a period of time (24).

This study will be prospective as the data will be collected at the time the study takes place. The exposure to FOI, the practice of FOI as well as confidence of anaesthetists to perform FOI will be described.

A contextual study refers to a particular population or group referred to as a “small-scale world” (25). Examples include a ward or a clinic in the hospital. This study will be conducted amongst anaesthetists working in the Department of Anaesthesiology at Wits and is therefore contextual.

A descriptive study examines certain characteristics of a population as they naturally occur (26). This study will describe the current practice of awake FOI.

5.8.2 Study population

The study population consists of the anaesthetists working in the Department of Anaesthesiology.

5.8.3 Study sample

5.8.3.1 Sample method

In this study a convenience sampling method will be used. Convenience sampling or availability sampling involves participants that are readily available to the researcher (24). All anaesthetists attending academic meetings will be approached to participate in the study.

5.8.3.2 Sample size

The Department of Anaesthesiology consist of 219 anaesthetists. Questionnaires will be administrated to the entire accessible population. A response rate of approximately 60% (131 participants) will be considered acceptable.

5.8.3.3 Inclusion and exclusion criteria

Inclusion criteria in this study are:

- all anaesthetists attending the academic departmental meetings
- anaesthetists agreeing to participate
- complete and incomplete questionnaires.

Exclusion criteria in this study are questionnaires returned blank.

5.8.4 Data collection

5.8.4.1 Development of a questionnaire

A questionnaire was chosen as an instrument for data collection because it:

- determines what people know, think or believe
- is an effective tool to direct questions to the population of concern
- allows data collection from large groups (24).

After reviewing the literature, a draft questionnaire (Appendix 1) was developed by the researcher ensuring content validity. Face validity was ensured by incorporating the suggestions of three anaesthesiologists with airway expertise reviewing the questionnaire. It should take participants no longer than 15 minutes to complete the questionnaire.

The self-administered questionnaire (Appendix 1) consists out of 3 sections.

Section 1 includes the following demographic data:

- age
- gender
- years of experience in anaesthesia
- professional designation.

Section 2 contains questions regarding exposure to and confidence in performing awake FOI including:

- number of FOI's performed
- how participants were trained in FOI
- level of confidence
- aspects contributing to proficiency in this skill.

Section 3 consists of questions regarding the process of performing FOI:

- positioning the patient
- pre-medication
- sedation
- topical anaesthesia
- positioning of the anaesthetist.

5.8.4.2 Data collection process

The data will be collected at the departmental academic meetings. Questionnaires will be handed out to attendees who are willing to participate. An information letter (Appendix 2) regarding the study will be attached

to the questionnaire. The researcher will be present throughout to attend to queries. Participants will return questionnaires to a sealed box marked “returned questionnaires”.

Blank questionnaires returned will be used to calculate the response rate but will not be included in the analysis of the data. Incomplete questionnaires will be included provided that more than 80% of the section on practice has been completed.

5.8.5 Data analysis

Data will be entered into a Microsoft Excel[®] spreadsheet and analysed using descriptive and inferential statistics. The statistical program Statistica version 12.5 will be used.

Categorical data will be analysed using frequencies and percentages and comparisons will be done using a Chi² or Fishers Exact test.

5.9 Significance of the study

Anaesthetists should regularly perform awake FOI to acquire and maintain both the skills and confidence to appropriately manage the anticipated difficult airway. If anaesthetists are not adequately exposed to the practice of awake FOI, teaching opportunities could be established to ensure anaesthetists become proficient in FOI. Performing awake FOI in a structured and standardised fashion may be especially beneficial for trainee anaesthetists. Auditing the practice of awake FOI in the Wits Department of Anaesthesiology may identify variability in the methods utilised during this procedure. A standard operating procedure for the process of awake FOI may be developed which may ultimately optimise patient care.

5.10 Validity and reliability of the study

Validity describes the extent to which a true value is being represented by a measurement. A study is valid if the conclusions are justified based on the study design (27).

Reliability refers to the consistency with which a measure is achieved and to which random error occurs (27).

In this study validity and reliability will be maintained by the following:

- applying the appropriate research design
- reviewing the literature for content validity of the questionnaire
- incorporating suggestions of three anaesthesiology airway experts to ensure face validity of the questionnaire
- completion of a standardised questionnaire by participants
- preventing data contamination by the researcher being present during data collection
- checking every 10th data entry point for accuracy.

5.11 Potential limitations of the study

The contextual design of the study means that the results may not be generalizable to other anaesthesiology departments. It will however provide valuable information regarding the practice of FOI in the Wits Department of Anaesthesiology.

A convenience sample may not adequately represent the practice of the entire Wits Department of Anaesthesiology but rather that of the participants present at the meeting. The results may therefore over- or under represent certain elements.

The sample size will be determined by the willingness of the attendees to participate. A small sample size may limit the comparison between the professional designation and the level of confidence.

5.12 Project outline

Activity	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	June 2016	Jul 2016	Aug 2016	Sept 2016	Oct 2016
Proposal										
Proposal submission										
Ethics approval										
Postgrad Approval										
Data collection										
Data analysis										
Chapter 4,5										
Submission										

5.13 Financial plan

The Department of Anaesthesiology will incur the cost of printing and paper for the proposal, ethics and postgraduate approvals and questionnaires.

Item	Number	Cost	Total
Printing	1000	R1/page	R1000
Binding	4	R200	R800
Total			R1800

5.14 References

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Appendix 1: Questionnaire

Please mark the appropriate box with X. In section 3, more than one answer may apply.

Section 1 – Demographic information

1.1 Gender	
Male	
Female	

1.2 Age	
25-30 years	
31-35 years	
36-40 years	
41-45 years	
46-50 years	
>50years	

1.3 Professional designation	
Medical officer	
Registrar – 1 st , 2 nd , 3 rd year	
Registrar – 4 th year	
Career medical officer/Consultant	

1.4 Years of experience in anaesthesia	
≤5 years	
>5 years	

Section 2 – Exposure and training

2.1 Approximately how many awake fiberoptic intubations have you performed?	
Nil	
1-5	
6-10	
11-20	
20-50	
>50	

If you have selected 'Nil' in 2.1 please do not proceed with the questionnaire.

2.2 On average how often do you usually perform awake fiberoptic intubation?	
Almost never	
Daily	
Weekly	
Monthly	
Annually	
Other	

If other, please specify.

.....

.....

2.3 How were you trained to perform fiberoptic intubation? More than one option may apply.	
Nil	
Manikin	
Simulator	
Patient - asleep	
Patient - awake	
Other	

If other, please specify.

.....

.....

2.4 How would you rate your level of confidence in performing awake fiberoptic intubation?	
Very low	
Low	
Average	
High	
Very high	

2.5 How would you rate the contribution of the following aspects to your proficiency in this skill?	Strongly agree	Agree	Disagree	Strongly disagree
Equipment availability				
Equipment functionality				
Number of cases available				
Practicing on normal airways				
Airway workshops				
Time available				
Availability of a FOI algorithm				

Section 3 – Practice of awake fiberoptic intubation

3.1 How do you usually position the patient?	
Prone	
Sitting	
Supine	
Other	

If other, please specify.

.....

.....

3.2 (a) Do you administer premedication?	Yes	
	No	

3.2 (b) If yes, please indicate the drug(s), dose and route of administration.	Indicate with X	Dose in a 70kg patient	Route of administration
Atropine			
Glycopyrrolate			
Scopolamine			
Other			

If other, please specify drug, dose and route of administration.

.....

.....

3.3 (a) Do you sedate the patient?	Yes	
	No	

3.3 (b) If yes, which technique do you usually use?	
Titrate boluses	
Infusion	
Target Controlled Infusion	
Other	

If other, please specify.

.....

3.3 (c) Which drug(s) do you usually use for sedation?	
Midazolam	
Diazepam	
Fentanyl	
Remifentanyl	
Propofol	
Ketamine	
Dexmedetomidine	
Other	

If other, please specify.

.....

.....

3.4 (a) Do you apply topical anaesthesia to the airway prior to intubation?	Yes	
	No	

3.4 (b) If yes, which technique(s) do you use?	
Apply soaked swabs	
Apply gel or ointment	
Nebulise	
Spray	
Spray-as-you-go	
Other	

If other, please specify.

.....

.....

3.4 (c) Which drug(s) do you use for topicalisation?	
Benzocaine	
Bupivacaine 0.5%	
Cocaine	
Lignocaine 2%	
Lignocaine 10%	
Tetracaine	
Other	

If other, please specify.

.....

.....

3.5 How do you usually position yourself to intubate?	
Facing the patient	
Behind the patient	
Elevated	
Same level as the patient	
Other	

If other, please specify.

.....

.....

3.6 Which approach do you usually use?	
Oral	
Nasal	
Retrograde	

Appendix 2: Information sheet

Dear Colleague

My name is Dr Elize van Rooy. I am a registrar in the Wits Department of Anaesthesiology. I would like to invite you to participate in a research project titled “Anaesthetists’ practice of awake fiberoptic intubation in adult patients“. The study report will be submitted to the Faculty of Health Sciences at the University of the Witwatersrand to for partial fulfilment of the requirements for my MMed degree.

The aim of the study is to describe the exposure, level of confidence and practice of awake fiberoptic intubation in adult patients by anaesthetists working in the Wits Department of Anaesthesiology. As airway specialists it is important that the anaesthetist can skilfully manage the anticipated difficult airway in a confident manner. This will be determined by a self-administered questionnaire.

Participation is completely voluntary and consent will be implied by your completion and return of a questionnaire. Information will be kept confidential and anonymous as none of your personal details will be required and only the researcher and supervisors will have access to the raw data. There is no penalty for not participating in the study.

Kindly return all questionnaires, whether completed or not, to the box marked “returned questionnaires“. The numbering of questionnaires is simply for determining the response rate and for data capturing purposes.

Completing the questionnaire should take no longer than 15 minutes. Participants are encouraged not to share information as this can produce inaccurate results. No incentives will be provided for completing the questionnaire.

Please ensure that you understand the above information prior to completing the survey.

Thank you for taking the time to read this information section. If you have any questions please do not hesitate to contact us:

Elize van Rooy (researcher): 082 569 7947

The Chairman of the HREC: (011) 717 1234

Yours sincerely,

Elize van Rooy