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Training course in local anaesthesia of the airway and fibreoptic intubation using course delegates as subjects

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Background. We describe a practical method of training anaesthetists in the technique of awake fibreoptic intubation. This is performed on a training course using the delegates as subjects.

Methods. The first 15 subjects underwent cardiovascular monitoring during airway fibreoptic endoscopy performed by other course members. They were subsequently interrogated by use of a questionnaire.

Results. Evidence from questionnaires suggests this method of instruction is acceptable in this self-selected group of individuals. Gagging was the commonest unpleasant side-effect of airway endoscopy, although only one delegate rated this as uncomfortable. Fifty-four per cent of subjects found the procedure slightly painful; 46% reported no pain at all. Overall, the procedure was rated as acceptable by 85% of subjects and enjoyable by 15% of subjects. No delegate found endoscopy or intubation distressing. Cardiovascular monitoring revealed pulse rate and arterial pressure changes of less than 25% of baseline values. Paraesthesia developed in one individual and nasal bleeding in two cases, neither of which was clinically significant and did not interfere with endoscopy.

Conclusions. The use of course delegates as subjects for training was acceptable to anaesthetists and is associated with a low level of discomfort and morbidity.

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Provision of training on local anaesthesia of the airway and fibreoptic endoscopy is difficult for many reasons including a lack of suitable patients, ethical considerations and time pressure in the clinical environment.[1] For these reasons, we designed a course to enable delegates to develop, refine and practice their skills in airway anaesthesia and endoscopy of live human subjects. Mannequins and models offer an alternative but are anatomically unrealistic, over-simplified, immobile, uncontaminated with secretions, and do not offer an adequate challenge. Mannequins help to develop motor skills, but do little to build the confidence necessary for use in a clinical situation. Though our method of training does not provide instruction in the management of specific airway problems, it does enable familiarization with normal human endoscopic anatomy. In a course of six participants and two observers, each participant would be expected to perform at least four nasendoscopies to the level of the larynx and a further endoscopy to the carina, followed by the passage of a tracheal tube over the endoscope. With the aid of a video-display system, each delegate should also witness a further 20 nasendoscopies and directly observe the passage of five tracheal tubes.

In this paper, we report complications and assess the satisfaction of delegates attending this course.

Methods

The course is open to anaesthetists of all grades. There are two levels of entry, as an observer or as a participant. All participants receive an explicit warning of the risks of the procedure. Observers do not participate in all practical sessions and do not undergo endoscopy. Information is

provided on an application form (Appendix A), with a detailed subjective description of endoscopy and intubation (Appendix B), in addition to an explicit consent form (Appendix C). Participants complete a consent form on application. Consent is reaffirmed immediately prior to undergoing endoscopy. Our trust (Norfolk and Norwich Hospital University Hospital NHS Trust) solicitors were consulted in order to ensure that the trust's liabilities would be covered in the event of a serious complication.

Delegates with a history of the following conditions were excluded as participants: nose problems, any infectious disease, hypertension, heart disease, liver disease, epilepsy, diabetes, asthma or pregnancy.

In common with many other courses, instruction is provided in care of the endoscope, endoscopy technique, airway anatomy, indications for awake intubation, local anaesthesia of the airway, and tracheal intubation. Lectures and video demonstrations are supported by practical sessions using mannequins and the artificial throat endoscopy model.[2] During practical endoscopy sessions on models and mannequins, delegates are divided into small groups, each under the supervision of an instructor in order to ensure all delegates understand and can demonstrate the practical principles of endoscopy. All participants were informed that if they found the endoscopy or intubation uncomfortable or wanted to stop, they should raise their arm. Further local anaesthetic could then be administered or the procedure would be abandoned.

Human endoscopy sessions take place in an operating theatre with full resuscitation facilities available. Video cameras are used with all endoscopes and provide multiple viewing screens. All endoscopists wear operating theatre clothes and gloves; gloves are discarded after each procedure. Endoscopes undergo routine disinfection between subjects in line with our trust/hospital policy. This policy involves glutaraldehyde disinfection with a contact time of 20 min, as currently recommended by the British Thoracic Society.[3] All endoscopes are leak tested at the beginning and end of each session.

Prior to performing endoscopy on course participants, all delegates perform endoscopy on an instructor, the delegate passes a nasotracheal tube. The following day, participating delegates act as endoscopy subjects following a 4-h fast.

Routine baseline monitoring of non-invasive arterial pressure, continuous oximetry and ECG is established, then recorded at 5-min intervals throughout the procedure. Intravenous access is gained with a 20-gauge cannula and i.v. glycopyrrolate 3 μg kg^{-1} is administered as an antisialagogue, to improve the view and to enhance local anaesthetic effectiveness.[4] This is followed by two puffs of 0.1% xylometazoline to each nostril prior to topical anaesthesia of the airway. Nebulized 4% lidocaine 160 mg is delivered over a 10-min period using a standard Intersurgical nebulizer with oxygen 10 litre min^{-1} as a driving gas. Superficial nasendoscopy is performed to select the largest nostril for local anaesthesia, endoscopy and intubation. The selected nostril is anaesthetised with 2.5 ml of 5% lidocaine solution containing 0.5% phenylephrine. After insertion of the endoscope, further doses of 4% lidocaine are administered to the lower airway via the working channel of the endoscope using an epidural catheter with an end hole as a conduit, in the manner described by O'Hare.[5] Subjects are asked to take slow regular deep breaths to facilitate distribution of local anaesthetic spray. Laryngeal anaesthesia is judged to be adequate when the larynx ceases to react to the application of local anaesthetic. This is then followed by further local anaesthetic administration to the lower airway. The maximum dose of topical lidocaine is limited to 9 mg kg^{-1}.[6] Nasotracheal intubation using a Portex Ivory blue line tube is then performed by a participating delegate under the direct supervision of the instructors.

If the nasal cavity was found to be too small to permit the passage of a Keymed LF-GP fibreoptic laryngoscope or a 6.0-mm uncuffed nasotracheal tube, intubation was abandoned. No sedation or local or i.v. anaesthetic injections were administered. Supplemental oxygen was administered to all delegates via nasal cannulae during airway endoscopy. Oxygen saturation, heart rate and arterial pressure recordings were continued until completion of intubation and removal of the tracheal tube.

Data were collected from the application forms about the sex, seniority and previous endoscopy experience of all delegates.

On completion of the course, all participants completed a feedback form (Appendix D). They were asked to grade the acceptability of endoscopy and intubation with regard to pain, anxiety, coughing, and gagging. In addition, they were asked to report any other adverse experiences. All delegates were asked to give an overall evaluation of the course on a graded scale of very poor to excellent. Heart rate and arterial pressure measurements of two instructors who underwent demonstration endoscopy are included in this report; feedback forms were not collected from them.

Following the practical session, delegates were given direct feedback from their supervising instructor. Instructors emphasize that the course is only a part of the training they will need in airway management. In addition, they give advice on how to develop and maintain endoscopy skills.

Results

Background information

Data were collected from 15 subjects on three separate courses over a period of 6 months. There were 11 males and four females, with an age range of 25–50 yr.

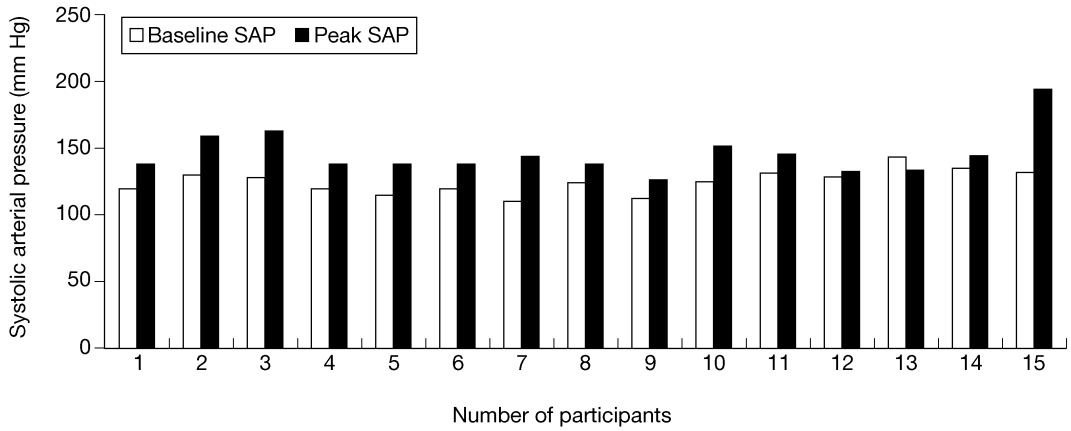

Fig 1 Baseline and peak systolic arterial pressure of the participants.

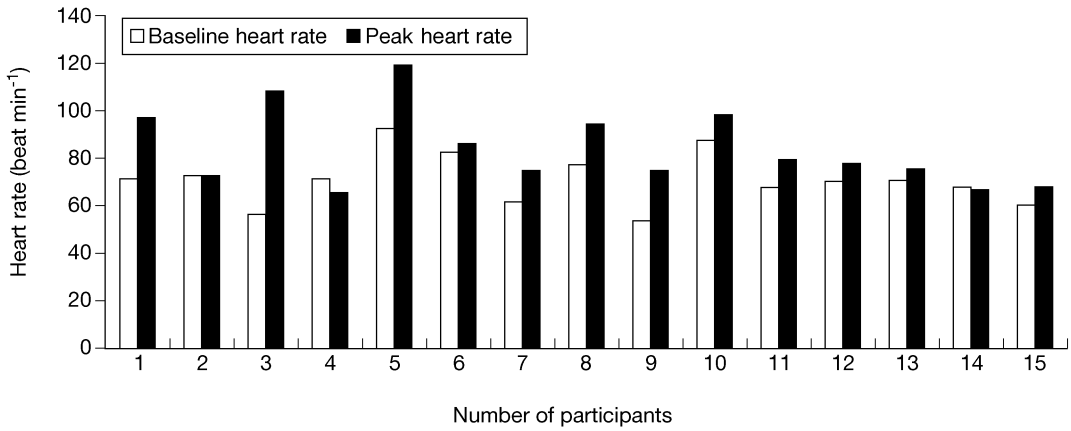

Fig 2 Baseline and peak heart rate of the participants.

Previous experience

The experience level of our course delegates was diverse. Six delegates had performed fewer than five endoscopies each. Two had performed one each and two delegates had no previous experience at all. The average previous experience was 19 endoscopies; however, this was skewed by two individuals who had both performed over 50, and by five others who had performed 25 or more. One delegate had performed 12 solo endoscopies, having never performed one under supervision. Six delegates had never performed an awake intubation whilst two delegates had experience of five awake intubations.

Duration of procedure

The duration of each procedure varied from 35 to 70 min with an average duration of 55 min. The number of heart rate and arterial pressure estimations varied from 8 to 15 per subject with an average of 12.

Haemodynamic data

Figure 1 shows the baseline systolic and peak recorded arterial pressure of each participant. A peak systolic arterial pressure of greater than 120% of baseline was recorded in four subjects (number 2, 3, 5 and 10), and an increase to greater than 130% was seen in one subject (number 7 from 110 to 144 mm Hg). The greatest rise was seen in subject number 15 where the systolic value rose to 195 mm Hg from a baseline of 133 mm Hg (147% of baseline). This figure was preceded and succeeded by two lower values of 136 mm Hg and 126 mm Hg respectively, suggesting a possible measurement artefact. Figure 2 shows the baseline and peak heart rate of each participant. A rise in heart rate to within 120% of baseline was seen in 10 cases (numbers 2, 4, 6, 7, 10, 11, 12, 13, 14 and 15), to over 130% in two (number 1 and 9), and to over 150% in one case (number 3).

ECG and oximetry

Continuous monitoring of the ECG and oxygen saturation failed to reveal any significant abnormality other than changes in heart rate. No treatment or intervention was required.

Table 1 Subjective response of participants to the overall experience of undergoing the procedure, pain felt during the procedure, anxiety felt during the procedure and coughing and gagging experienced during the procedure. Since two of the subjects were instructors on the course, feed back forms were not collected from them

Overall experience		**Pain**		**Anxiety**		**Coughing/gagging**	
Very distressing	0	Very painful	0	Very worrying	0	Very uncomfortable	0
Distressing	0	Painful	0	Worrying	1	Uncomfortable	1
Acceptable	11	Slightly painful	6	Slightly worrying	6	Slightly uncomfortable	8
Enjoyable	2	Not at all painful	7	Not at all worrying	6	Not at all uncomfortable	4
Very enjoyable	0	Enjoyable	0	Enjoyable	0	Enjoyable	0
Total participants	13		13		13		13

Complications

Paraesthesia

One delegate complained of severe paraesthesia and numbness in the hands and feet prior to intubation. The procedure was abandoned, following which the tingling sensation settled over the next 20 min.

Nasal bleeding

Slight bleeding from the inferior turbinate was observed in two participants. Nasal bleeding caused no distress and settled without treatment. It did not interfere with endoscopy.

Coughing

All delegates coughed at some stage during the procedure. There were no episodes of laryngospasm or bronchospasm.

Sore throat

Two delegates recorded post-procedural sore throat; none reported voice changes.

Intubations

The carina was visualized in all 15 subjects; intubation was completed in 10. Nasal obstruction prevented nasotracheal intubation in three cases. Inadequate analgesia caused failure to intubate in one case and the procedure was abandoned in the one individual who developed paraesthesia of the hands and feet.

Subjective responses

All participants graded the overall experience as acceptable. The subjective responses are shown in Table 1. Seven participants (54%) experienced no pain during the procedure; six participants (46%) experienced slight pain. Anxiety was common and was experienced by seven participants (54%); six participants (46%) reported no anxiety. Coughing and gagging were rated as uncomfortable by one individual (7%), and slightly uncomfortable by eight (62%) participants; four participants (31%) reported no discomfort.

The course overall was rated as excellent by 100% of delegates, all of whom returned a completed evaluation form (Appendix D). Two reported that they found the experience of undergoing endoscopy beneficial, by aiding their recall of the technique and improving empathy when dealing with patients.

Discussion

No delegate found the procedure unacceptable. Reported levels of discomfort and anxiety were low. Only one participant found the procedure worrying and six participants found it slightly worrying (Table 1). However, a course of this kind could be predicted to select individuals most likely to find this type of procedure acceptable. The findings reported here may not therefore be reproduced from a cross-section of the population.

Heart rate and arterial pressure changes during a practical procedure may give an objective indication of the distress or discomfort produced. A rise in heart rate was seen in all individuals at some stage during the endoscopy. The average maximum rise in heart rate was 13 beat min^{-1}, which represented 120% of the baseline value. Part of this increase may be attributable to administration of glycopyrrolate. In line with the heart rate changes, systolic arterial pressure increased in all individuals at some stage during the procedure, although the average maximal rise was 21 mm Hg to 117% of the baseline value.

One individual complained of dizziness and paraesthesia, symptoms that could be attributed to lidocaine toxicity. However, we frequently ask individuals to breathe deeply at some point during the endoscopy to aid the distribution of local anaesthetic. It is possible, therefore, that these symptoms could also have been attributed to hyperventilation. The sensation of tingling and dizziness resolved within 20–30 min of discontinuing endoscopy, at a time when plasma lidocaine levels would be expected to be elevated or even rising.[7 8]

Endoscopy to visualize the carina was completed in all subjects, though nasal intubation was performed in only 66%. The main objective of the course is to provide training in airway local anaesthesia and fibreoptic endoscopy. Many of the benefits of the course in developing endoscopy skills and learning local anaesthesia of the airway can be achieved without performing tracheal intubation. However, completion of the procedure allows the instructors to encourage gentleness, and gives the opportunity to demonstrate the

manoeuvres sometimes required to assist the passage of the tracheal tube. Perhaps most importantly, when delegates are given the opportunity to complete the intubation, their confidence in the validity of the local anaesthetic technique is enhanced.

The assertion that intubation attempts were abandoned in the event of any apparent distress is supported by the low levels of discomfort and high level of acceptability reported by delegates. Nevertheless, all delegates witnessed the technique of tracheal tube insertion, even if they did not successfully perform it themselves.

In conclusion, the use of course delegates as subjects for training in fibreoptic endoscopy is acceptable to some anaesthetists. Early assessment suggests that this is associated with a low level of discomfort and morbidity. Delegates found this type of instruction beneficial.

Appendix A

Application forms for the observer and the participant on the Norwich Endoscopic Airway Training Course are given in Table 2.

Appendix B

The detailed subjective description of endoscopy and intubation is shown in Table 3.

Table 2 The Norwich Endoscopic Airway Training Course. Information required on the application forms for observers and participants

Application Form - Observer
Surname
First name
Sex
Address
Contact telephone numbers
Qualifications (with dates)
GMC registration number
Current grade
Current hospital
Level of experience in fibreoptic intubation (none/minimal/moderate/extensive)
Approximate number of fibreoptic intubations under general anaesthesia (under supervision/solo)
Approximate number of intubations under local anaesthesia (under supervision/solo)
What does the applicant hope to gain from this course?
If the course is oversubscribed would the applicant like to be offered a cancellation possibly at short notice?

Application Form - Participant
Surname
First name
Sex
Address
Contact telephone numbers
Qualifications (with dates)
GMC registration number
Current grade
Current hospital
Level of experience in fibreoptic intubation (none/minimal/moderate/extensive)
Approximate number of fibreoptic intubations under general anaesthesia (under supervision/solo)
Approximate number of intubations under local anaesthesia (under supervision/solo)
What does the applicant hope to gain from this course?
Weight of applicant in kg
Blood pressure of applicant in mm Hg
Resting pulse rate of applicant in beat/min
Does the applicant have any infectious diseases (such as Hepatitis B)?
Is the applicant on any medication other than the oral contraceptive pill?
Does the applicant suffer with any of the following:
Hypertension
Heart disease
Liver disease
Epilepsy
Diabetes
Asthma
Is the applicant pregnant?
A ‘yes’ answer to any of the above would mean the applicant could not become a participant
Any other current medical problems
Does the applicant suffer from nosebleeds?
List of all known allergies
Any history of nasal obstruction or nose problems
If the course is oversubscribed would the applicant like to be offered a cancellation possibly at short notice?

Table 3 Detailed subjective description of endoscopy and intubation

Intubation Under Local Anaesthetic! How safe is it?

Before volunteering for an awake intubation you will need to understand what is involved, the risks of the procedure and exactly how you can expect to feel during and afterwards.

This method of airway anaesthesia has been used repeatedly on patients, previous delegates and the instructors themselves, all of whom have undergone multiple tracheal intubations under local anaesthesia to refine their technique.

Method

The procedure takes place in an operating theatre with full resuscitation facilities available.

After a 4-h fast you will be weighed and routine monitoring established. This will be followed by topical xylometazoline (Otrivine) nose drops applied to both nostrils. A 20/22-gauge cannula is inserted into the dorsum of the hand or the antecubital fossa, and glycopyrrolate 200–400 μg given intravenously. Oxygen will be administered by nasal cannulae and followed by the topical application of lidocaine directly or as a fine spray throughout the airway via a fibreoptic scope. When satisfactory anaesthesia has been achieved and tested a 6.0 nasotracheal or orotracheal tube will be passed into the trachea. Airway anaesthesia, endoscopy and intubation will be performed by course members under direct supervision of an experienced consultant. Each delegate will perform part of the procedure on the subject, the last delegate will perform endoscopy and tracheal intubation. Pulse, BP and Sa_{O_2} will be monitored at frequent intervals during the procedure. No local anaesthetic injections, cocaine or sedation will be used.

Risks

Trauma to the airway from nose to main bronchi including bleeding or perforation and abscess formation.

Allergic reactions to lidocaine, glycopyrrolate or phenylephrine.

Drug toxicity due to lidocaine resulting in convulsions, myocardial depression or cardiac arrest.

Aspiration of gastric contents.

Infection: localized or systemic, due to hepatitis B, hepatitis C, HIV, TB, CJD and any other contaminating organisms.

With the exception of minor nasopharyngeal trauma, none of these complications has been observed during the preparatory stages. Doses of lidocaine applied to the airway are large (up to 9 mg kg^{-1}). These have been found to be acceptable in patients undergoing bronchoscopy (Efthimiou J, Higenbottam T, Holt D, Cochrane GM. Plasma concentrations of lignocaine during fibreoptic bronchoscopy. *Thorax* 1982; **37**: 68–71). Awake fibreoptic intubation has been reported to be safe in patients at risk of aspiration (Ovassapian A, Krejcie TC, Yelich SJ, Dykes MHM. Awake fibreoptic intubation in patients at high risk of aspiration. *Br J Anaesth* 1989; **62**: 13–16).

How does it feel?

There is obviously a degree of apprehension associated with anticipation of an awake intubation. We observe a 4-h fast before the procedure, but despite this it is advisable to ensure an empty bladder as the whole procedure may take an hour.

You will be settled in the supine position with head elevated on a fairly comfortable operating table. Monitoring will be applied – NIBP, ECG and pulse oximetry. After a period of stabilisation to give you time to settle down a small cannula will be inserted into the back of your hand or the antecubital fossa, whichever you prefer. Early preparation includes the application of a vasoconstrictor to the nose. We use xylometazoline two squirts to each nostril; this is a little uncomfortable and sometimes makes the eyes water. This is followed by the i.v. administration of glycopyrrolate 200–400 μg. Over the following 10 min the glycopyrrolate will produce a dry mouth. Nebulized 4% lidocaine is used to begin anaesthetising the upper airway. This is followed by the application of co-phenylcaine forte (0.5% phenylephrine, 5% lidocaine and 0.001% benzalkonium spray). Topical application of local anaesthetic spray to the airway tastes unpleasant, as lidocaine has a bitter taste and produces coughing or gagging. If the endoscope is advanced too early, before satisfactory anaesthesia has been achieved, this can cause swallowing coughing, gagging or retching.

When the larynx ceases to react to further increments of local anaesthetic the tracheal tube is passed through the nose. A small tube is used, through the largest nostril or through the mouth. As it passes through the nose the subject may hear some clicking noise though this is uncommon. In general, the procedure is well tolerated.

The tracheal tube position is confirmed, then it is removed. The subject will feel a certain degree of elation when the procedure is over. This sensation is enhanced by the effects of lidocaine which produces some dysphoria. Following the procedure the subject will be aware of a dry mouth which outlasts the procedure by 2–3 h and of nasal stuffiness similar to that which occurs in the early stages of a cold. When oropharyngeal sensation returns to normal we recommend a warm cold-cure drink containing aspirin or paracetamol to deal with the nasal discomfort. This usually settles after 12–14 h. Other useful things to have available are a Lipsyl stick for the dry mouth and some Vicks vaporub, which eases nasal stuffiness overnight.

Clearly in a course of this kind, it is essential that we exercise utmost caution. For this reason we are explicit about the risks and some delegates will be refused entry as participants. Participating delegates should not drive for 4 h after endoscopic intubation. Accommodation should be arranged locally following the course.

If you need additional information, or have concerns about a medical condition or the practical aspects of the course, please contact us.

Appendix C

The participant consent form is given in Table 4.

Appendix D

The feedback questionnaire is shown in Table 5.

Table 4 Information taken from page 3 of the Participant Application Form.

Consent to Intubation Under Local Anaesthesia
As a participant, the course will involve undergoing fibreoptic naso/orotracheal intubation under topical local anaesthesia. If you are unwilling to consent to this please apply for course attendance as an observer. Participants must not drive for 4 h after the procedure, therefore you must make arrangements to stay locally after the course. *Morbidity* Inevitably there is some discomfort during the procedure, mainly airway irritation which causes coughing. You should expect some post-procedural nasal stuffiness, lasting a few days and a dry mouth for 3–4 h. *Risks of awake fibreoptic intubation under local anaesthesia include* Trauma anywhere within the airway. Allergic reaction to latex, xylometazoline, lidocaine, or glycopyrrolate. Local anaesthetic toxicity, leading to convulsions or cardiac arrest. Aspiration of gastric contents. Infections, local or systemic, due to hepatitis B, hepatitis C, HIV, TB, CJD and any other contaminating organisms. Any queries? If you wish to discuss the course, or need further clarification, please contact our Course Administrator.
All applicants wishing to participate in, rather than observe the course should complete the consent form below. Consent to Tracheal Intubation Under Local Anaesthesia I wish to participate in the Norfolk and Norwich Endoscopic Airway Training Course and in doing so I am willing to act as a subject for tracheal intubation under topical local anaesthesia. I am aware of the possible risks of the procedure and of the alternative option, which is to apply to join the course as an observer. I am also aware that I must not drive a motor vehicle for at least four hours following the procedure. Please print your name ..... Signature .....Date ..... Your reaffirmation of consent will be sought at the time of training and you will be asked to sign the form below. Signature.....Date .....

Table 5 Feedback questionnaire. Participants are asked to complete the following questionnaire about the Norwich Endoscopic Airway Training Course before they leave at the end of the last day.

1) Were you an observer or participant? 2) What was your overall impression of the course? (circle one) Very Poor / Poor / Fair / Good / Excellent 3) How did you find the experience of endoscopy or intubation on yourself? (circle one) Very distressing / Distressing / Acceptable / Enjoyable / Very enjoyable 4) Considering different aspects of airway endoscopy or intubation on yourself, how would you rate the following categories? (circle one from each category) **Pain** Very painful / Painful / Slightly painful / Not painful at all / Enjoyable **Anxiety** Very worrying / Worrying / Slightly worrying / Not worrying at all / Enjoyable **Coughing / Gagging** Very uncomfortable / Uncomfortable / Slightly uncomfortable / Not uncomfortable at all / Enjoyable **Other sensation (Please specify)** Very uncomfortable / Uncomfortable / Slightly uncomfortable / Not uncomfortable at all / Enjoyable 5) If you experienced pain, anxiety, coughing / gagging or other sensations at what stage of the procedure did this happen? a) Pain b) Anxiety c) Coughing / Gagging d) Other sensation 6) Did you feel that you experienced any of the recognized side-effects of local anaesthetic drugs? Yes / No If "Yes" please specify At what stage did you experience these side-effects? How were they resolved and was this adequate? 7) Is there any other information we could have supplied before the course that you would have liked or that you feel would have improved either the educational content or the experience of fibreoptic intubation? 8) What, do you feel, are the specific strengths and weaknesses of this course? 9) Why did you decide to come on this course (what objectives did you hope to fulfil)? 10) Do you feel that this course has met your objectives? (Please describe any areas that the course has failed to meet your objectives.) 11) Would you recommend this course to a colleague? Yes / No If "Yes" why would you recommend it? If "No" why would you not recommend it? 12) Are there any other comments you would like to add?

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