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Difficult tracheal intubation in obstetrics

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Summary

Difficult intubation has been classified into four grades, according to the view obtainable at laryngoscopy. Frequency analysis suggests that, in obstetrics, the main cause of trouble is grade 3, in which the epiglottis can be seen, but not the cords. This group is fairly rare so that a proportion of anaesthetists will not meet the problem in their first few years and may thus be unprepared for it in obstetrics. However the problem can be simulated in routine anaesthesia, so that a drill for managing it can be practised. Laryngoscopy is carried out as usual, then the blade is lowered so that the epiglottis descends and hides the cords. Intubation has to be done blind, using the Macintosh method. This can be helpful as part of the training before starting in the maternity department, supplementing the Aberdeen drill.

Key words

Anaesthesia; obstetric.
Intubation, tracheal; technique, training.
Complications; aspiration.

Obstetric anaesthesia causes about 14 maternal deaths each year in the UK, with no improvement over the last decade. Difficulty with intubation is known to be the factor most commonly associated with disaster here[1] and in the USA.[2]

No text-book has a systematic analysis of difficult intubation. Normally the tongue blocks the line of vision, and lifting it forward clears the view. It follows that three main factors can cause difficulty, as shown in Fig. 1: forward displacement of the larynx (1), or the upper teeth (2), or backwards displacement of the tongue (3). Difficulty in opening the mouth, or extending the head, contributes to factor (2).

This picture explains why, contrary to what has quite often been written, the difficult case may be far from obvious. A short, thick neck with receding jaw is easily seen, as are prominent teeth. But what is not easy to see is the size and mobility of the tongue. Thus there may be nothing striking about the patient's appearance to give warning, as the photographs published by Tunstall make clear.[3] It also follows that if the difficult case is often unpredictable, then the recommendation that all such cases should be done by consultants is not practicable. It may work if and when reliable forecasts can be made.

The third conclusion from Figure 1 is that it suggests a logical way of classifying the causes of difficult intubation, according to the view

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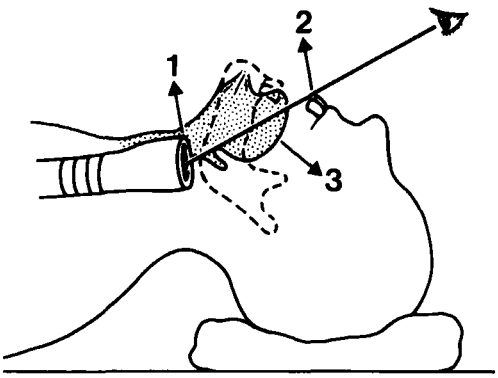

Fig. 1. Anatomical factors relevant to difficult intubation. At laryngoscopy the line of vision to the cords must be cleared. Difficulty may occur if the cords (1), the upper teeth (2), or the tongue (3), are displaced in the direction of the arrows. Even with no pathology, this may occur due to variation in the normal anatomy.

obtained at laryngoscopy (Fig. 2):

Grade 1. If most of the glottis is visible then there is no difficulty.

Grade 2. If only the posterior extremity of the glottis is visible then there may be slight difficulty. Light pressure on the larynx will nearly always bring at least the arytenoids into view, if not the cords.

Grade 3. If no part of the glottis can be seen, but only the epiglottis, then there may be fairly severe difficulty.

Grade 4. If not even the epiglottis can be exposed then intubation is impossible except by special methods. This situation is well recognised where there is obvious pathology, but is exceedingly rare if the anatomy is normal. The epiglottis is the key landmark. If it is not seen withdraw the laryngoscope blade slowly—often the epiglottis will drop into view, having previously been in front of the blade.

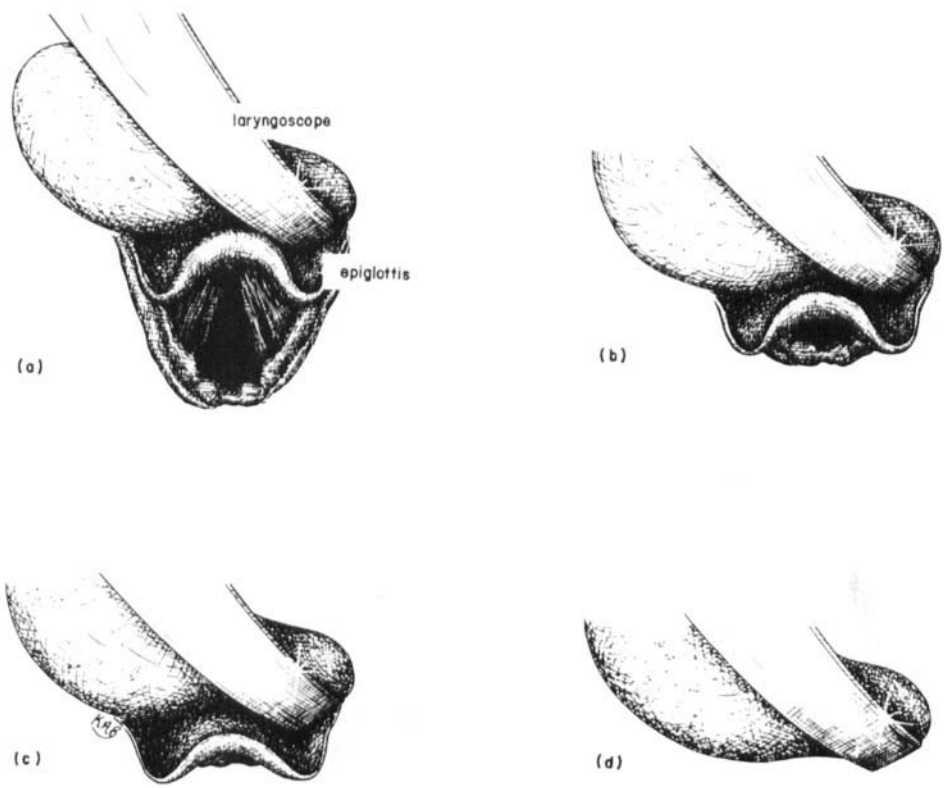

Fig. 2. These are the best views obtainable at laryngoscopy, assuming correct technique. The frequencies apply to patients without neck pathology. Severe pathology may produce grade 4, but otherwise this occurs rarely, if ever. Approximate frequencies are (a) grade 1, 99%; (b) grade 2, 1%; (c) grade 3, 1 per 2000; (d) grade 4, < 1 per 10^5.

Relevance to obstetrics

Grade 4 cases are probably not an appreciable cause of maternal deaths, for two reasons. Firstly, severe neck pathology is rare in obstetric patients and secondly, such cases are obvious in advance, whereas the evidence suggests that it is the unexpected difficulty that leads to disaster. This leaves grade 3 as the likely main cause. Such cases are often far from obvious in advance. They are also quite rare, so that a proportion of anaesthetists will not meet the problem before starting in obstetrics.

A simple statistical argument underlies this point. If the grade 3 case occurs about once every 2 years in routine work and if it takes about 8 years to become a consultant then each person can anticipate meeting this problem about four times before he is a consultant. But that is only the average result. If this is a random occurrence, then the individual probabilities can be predicted from the Poisson distribution (discussed in more detail elsewhere[4]). Most of us can expect to meet the problem three or four times in 8 years (Fig. 3), some as many as ten or eleven times. But the important block is the one on the left, showing that as many as 2% of anaesthetists would be expected to become consultants without ever having met the problem, purely due to the operation of the laws of chance.

This may help to explain why, in the most recent maternal mortality report, one of the deaths occurred despite the presence of a senior

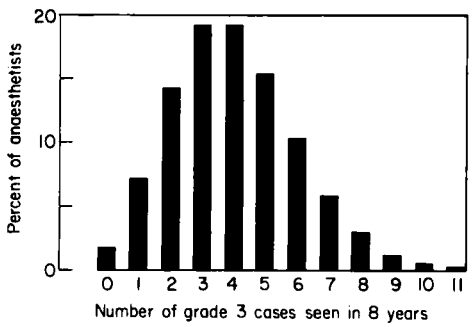

Fig. 3. If the number of grade 3 cases seen in 8 years, on average, is four, then the expected variation in frequency due to chance ranges from 0 to 11. The histogram shows the percentage of anaesthetists expected to see each of the numbers in this range. The predictions are from the Poisson equation,

$$p(n) = \frac{4^n e^{-4}}{n!}$$

anaesthetist. It may also account for the poor progress. Fifteen years ago obstetric anaesthetics were often given by beginners and, although this is now very rare, there has been disappointingly little improvement. Two years seniority is little better than two weeks if it does not include the necessary experience.

Disasters from failing to apply cricoid pressure are not easy to excuse. But inability to see the cords is alarming to anyone not prepared for it and an inappropriate reaction is understandable.

Possible solutions

If this analysis is broadly correct then it surely follows that one of the most promising suggestions in recent years is the drill suggested by Tunstall for failed intubation.[5] A copy of that drill, or something similar, could easily be posted in all maternity theatres, just to remind anyone working there that, if he is very unlucky, he may not be able to intubate so they must have a plan of action ready.

The second conclusion from our analysis is that although there are several ways of coping with failed intubation none is quite so sure to prevent aspiration as placement of a cuffed tube in the trachea. That is the only certain way of preventing aspiration of gastric contents, so it would help if the number of failed intubations could be reduced.

If the grade 3 case is the main cause of trouble and if it is rare, then none of us will have much experience of handling it if we rely solely on its random natural occurrence. It should help therefore deliberately to simulate it during any routine operating list. Laryngoscopy is carried out as usual, then the blade is lowered so that the epiglottis descends hiding the cords. The view is thus converted from the usual grade 1 to grade 3 (Fig. 2), so that intubation has to be performed blind. Many techniques have been suggested, but one that has stood the test of time derives from Macintosh.[6] He did not describe the method, but designed the equipment needed, namely a flexible introducer and a tracheal tube with anterior bevel (Oxford tube). The introducer can be inserted blind when necessary, and this is usually easy, provided the following points are held in mind. Keep the introducer well anterior, up against the epiglottis. This ensures that it does not enter the oesophagus. There are then only three places it can go, namely the trachea, or left or right

pyriform fossae. If it is kept in the mid-line then it will enter the trachea the first time, but if it deviates then it will stick in one of the pyriform fossae. It should then be withdrawn and shifted to the left or right.

The introducer should protrude at least 6 cm from the tube and once it has entered the larynx advanced well into the trachea. The tube will then follow. The introducer should be stiff enough to keep its shape against light pressure, but flexible enough to bend and go down the trachea once it is past the cords. The Oxford introducer has a retroussé tip, which helps.

A Magill tube may stick when it reaches the cords, particularly in a typical grade 3 case with a forward shifted larynx. Twisting the tube may allow it to enter, but is often traumatic. The Oxford tube is better in this situation because it was designed specifically for use with an introducer protruding from the end; the bevel is at the front.

This drill has been taught routinely at Northwick Park since 1978 and was discussed recently at a meeting of Anaesthetic Research Society.[7] It is started as soon as the trainee is confident with routine intubations. Usually the tube has entered the trachea first time, even when the anaesthetist has had only 2 or 3 months experience. Occasionally a second or third attempt has been needed. There is no risk to the patient and the time taken is similar to that for standard intubations. Once taught the trainee can practise the method without supervision, until he is confident with it.

The Macintosh technique is not the only way of handling the difficult case. By simulating grade 3 cases the individual can discover which method is most successful in his hands.

Results

In general our trainees have said that after practising this drill they had little difficulty when faced with a real problem. Genuine grade 3 cases successfully intubated have included Hurler's and Hunter's syndromes, moderately severe Still's disease, adult rheumatoid arthritis, as well as cases with no pathology.

It is not yet possible to prove that this scheme reduces the number of failed intubations, as the rarity of this occurrence means that a study confined to one unit would take decades to collect the necessary data. The advance of knowledge in this field depends on multicentre testing, as has been done for the antacid regimen. Care is needed therefore in deciding what measures, if any, are worth testing on a large scale. The antacid regimen adds significantly to the midwives' work-load, costs thousands of pounds and has given disappointing results. By contrast, the Aberdeen drill and the one we advocate are both simple measures, which do not add appreciably to anyone's work-load, cost nothing and may work.

Discussion

Prediction

Clearly it would help if the difficult case could be forecast reliably, but there have been few studies of this problem. A prospective study[8] on 70 cases of severe Still's disease found that intubation varied from easy to impossible. Inspection together with radiology gave little guidance, so that the classification had to be completed retrospectively.

Another study[9] compared 13 difficult cases with 13 controls and found the classical signs of little value. X-ray measurements of the facial skeleton were made and the best predictor was the posterior depth of the mandible. Presumably a deep mandible tends to go with a large, relatively immobile tongue. But even this was not a perfect predictor, there being an overlap of two cases between control and test groups. The ratio of mandibular depth to length was originally thought a better predictor, but later this proved not so (A. White, personal communication).

Recently the data of this study have been re-analysed to see if a combination of measurements might improve the prediction (C. Doré, personal communication). Multivariate analysis was carried out by computer and the best combination found was: measurement (6), depth of mandible; measurement (10), gap from occiput to atlas spine. This pair correctly classified all 25 available cases—the remaining case had no measurement (10) recorded. Clearly X-ray analysis merits further study. A small (10) suggests limited head extension.

Other causes of difficulty

Probably the commonest cause of difficulty for the beginner is not putting the patient's head in the Magill position. Magill[10] showed that the

natural tendency to extend the neck is a mistake, since it actually makes intubation more difficult. On the contrary, the neck should be flexed, which 'may require the insertion of a pillow', whilst 'the head is extended on the atlas'.

Thus the two main requirements had been clearly stated in 1930. Yet over a decade later many anaesthetists had not grasped these points, as the study of Bannister & Macbeth[11] shows. Magill's original description has never been bettered and can be recommended to all anaesthetists. (He remarks that intubation makes possible a much lighter plane of anaesthesia, so his paper was also a forerunner of modern light anaesthesia).

Frequency

The frequencies given in Fig. 2 are inevitably approximate, because no large survey has been done. The most important figures are those for the difficult grades, 3 and 4. Since these are rare a large survey would be needed to get reasonably narrow confidence limits. The nearest to this is the Cardiff survey of over 100000 computerized anaesthetic records (K.R. Murrin, personal communication). About 1% of intubations were rated as difficult. However, this survey asked the anaesthetist to state only if intubation was difficult and a much higher incidence of difficulty was reported by beginners. Probably this is because the novice tends to rate grade 2 cases as difficult, whereas anyone familiar with using an introducer will find grade 2 cases just as easy as grade 1. Thus a computer survey like the Cardiff one, but including a question on the grading, would help us to see this problem more clearly.

Consequences of error

The frequencies for grades 3 and 4 in Fig. 2 are based on the testimony of five senior anaesthetists at this hospital. This experience covers many years and the figures are therefore subject to the limitations of recall. If they are wrong, how might this affect the conclusions given above? Consider the worst possibility, namely that grade 4 cases might be much commoner than estimated, occurring without warning and accounting for all the deaths. If that is right then the drill we advocate would not, by itself, alter the mortality, because it is not reliable for grade 4 cases. However, the simulated difficult intubation drill was never intended to replace the failed intubation drill, and both are needed. For most hospitals grade 4 cases mean failed intubation, but prompt implementation of the Aberdeen drill should prevent disaster.

Now suppose the error is the other way and that most disasters are associated with grade 2 cases; certainly failed intubations have occurred in patients who later proved easy to intubate. In that case the drill we advocate should help, because the Macintosh method works for both grade 2 and 3 cases. For grade 2 cases the introducer can be inserted under direct vision, which is easy provided the anaesthetist has practised using an introducer. In fact the method works for grade 1 cases as well, so that some anaesthetists use it for all intubations.

Guidelines

Guidelines for the fairly inexperienced should be clear-cut. In our view it is always worth attempting to intubate grade 3 cases, but never worth it for grade 4 cases, in obstetric practice.

Grade 3 cases. Most, if not all, these cases should be intubated fairly easily, provided the Macintosh method has been practised. It is important not to waste time. After checking the position and finding that only the epiglottis can be seen it is pointless spending any more time trying to see the cords. Insert the tube as described; if it enters the oesophagus withdraw it, suck out the pharynx and try again. The tube will usually enter the trachea at the first attempt but, if necessary, there should be time for three attempts before hypoxia develops. Careful preoxygenation is always important. Note that intubating the oesophagus may nullify cricoid pressure and a flood of gastric contents is likely, but the drill is easy, namely remove the tube, re-apply cricoid pressure, suck out and, if needed, give oxygen, in that order.

Common sense is needed, but in general it would be reasonable to make three attempts before starting the failed intubation routine.

Grade 4 cases. The Macintosh method is not suitable because its success depends on using the epiglottis as a guide. If the epiglottis cannot be seen, keeping the introducer well forward causes it to stick at the epiglottis and then moving it back makes it enter the oesophagus. Success is possible, but is largely a matter of luck; in general the failed intubation drill should be started with-

out delay. The main options are: general anaesthesia without a tube, as described by Tunstall,[5] local infiltration, spinal or epidural anaesthesia. Choice of method will be determined mostly by the experience of the staff available. Severe neck pathology gives warning of the possibility of grade 4 problems and a senior anaesthetist should be notified in advance.

Pathology

In adults severe rheumatoid, or osteoarthritis, and ankylosing spondylitis can produce grade 4 cases. Involvement of the neck vertebrae may make it impossible to put the head in the Magill position. Pathology of the temporomandibular joint may limit opening of the mouth so that laryngoscopy is impossible. Induration of the tongue from carcinoma may limit its movement. Fibrosis from burns, or other causes, may produce similar problems. All these are rare in obstetrics and none has figured in the Confidential Enquiries. Still's disease is probably the most likely, but no figures are available on its incidence.

The guideline that grade 4 cases rule out intubation does not always apply. Such cases can be intubated by a number of special techniques. But a technique like fibreoscopy should be used in obstetrics only by someone who is expert with it. Thus it remains true that, in most instances, grade 4 cases mean failed intubation.

Sellick's manoeuvre[12]

Recent work[13] has shown that, even when correctly applied, cricoid pressure may not always be completely effective. Nevertheless it will convert a flood into a trickle. Intubation is impossible in a flood, but a trickle is manageable, provided there is a head down tilt and suction available. Should flooding persist despite cricoid pressure there would be no option but the head down, lateral routine with suction.

Ventilation with oxygen while maintaining cricoid pressure is usually easy, but difficult intubation is sometimes associated with difficulty in maintaining the airway. A longer Guedel, or a nasopharyngeal airway, may be needed. Releasing cricoid pressure must be a last resort, and if done the patient must be put head down on her side.

The only contraindication to cricoid pressure is active vomiting, which can rupture the oesophagus. Again the head down, lateral position is needed. Usually the patient will be paralysed, in which case active vomiting cannot occur. If the assistant is inexperienced a minute spent marking the cricoid and demonstrating the manoeuvre is advisable—blaming the assistant will not necessarily gain sympathetic hearing if disaster occurs. In our view, cricoid pressure, with the caveats noted, is crucial.

Conclusions

The confidential enquiries have focused attention on obstetrics, but difficult intubation can occur unexpectedly in any context and in the full stomach situation the hazards are the same as in obstetrics. It follows that the relevant training should be started early.

Senior anaesthetists cannot be blamed for not being present at all difficult intubations when these are unpredictable, but we have to ensure that those in the front line are adequately drilled. The three main drills concern difficult intubation, failed intubation and the correct use of cricoid pressure. They need as much attention as the cardiac arrest drill, but whether they always get it seems doubtful at present.

The evidence is that disasters occur not from exotic causes, more from the well-known problem for which standard procedures were not applied. The grade 3 case is between the exotic and the everyday, so the situation resembles air travel. Serious problems are rare on routine flights, therefore ensuring that pilots are trained to cope with them is not easy, but simulation methods have proved useful and all British Airways pilots have to carry out emergency drills in a flight simulator at regular intervals. If the grade 3 case is fairly rare how can we train others in handling it except by simulating it on routine lists? It may not be a perfect simulation, but it is better than no practice at all. 'Using an unfamiliar method in an emergency is a recipe for disaster. Even one preventable death is one too many.' (T.C. Gray, 1982. Symposium on difficult intubation at the Royal College of Surgeons of England).

Acknowledgments

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