CORRESPONDENCE

Sternal distance as predictor of difficult laryngoscopy

Sir,—I should like to comment on the article of Ramadhani and colleagues1 which described the use of measurement of sternal distance in the prediction of difficult laryngoscopy. The sensitivity and specificity of the test, using different “cut-off” or threshold values for sternal distance, were calculated. The authors stated that “using discriminant analysis, a sternal distance of 13.5 cm or less was calculated as the most accurate cut-off point for discriminating between difficult (grades III and IV) and easy (grades I and II) laryngoscopy”. There is, however, no rigid statistical way in which cut-off values can be determined in diagnostic tests involving continuous quantitative data. Such values depend on the specific nature of the test and are usually determined by clinical consensus, based on whether or not an excess of false positives is less important than an excess of false negatives, or vice versa.2

In this study, the prevalence of difficult laryngoscopy was 0.035 (3.5%). This can be interpreted as the probability that a patient will present difficulty at laryngoscopy before the test is carried out, and so it is known as the prior probability. Similarly, the prior probability that the patient’s trachea will be easy to intubate is 0.965. The positive and negative predictive values are the revised estimates of these probabilities in patients who are positive and negative to the test, and are known as the posterior probabilities. The difference between prior and posterior probabilities at any given cut-off level is one way of assessing the usefulness of a test.3 For the cut-off point of 13.5 cm, being test positive only increases the prior probability from 0.035 to a posterior probability of 0.076. In other words, being test positive only increases a patient’s probability of being a difficult laryngoscopy by approximately 4 percentage points. Similarly, being test negative increases the prior probability of 0.965 to a posterior probability of 0.984, which represents an increase in probability of an easy laryngoscopy of only 1.9 percentage points.

More importantly however, before the fine details of optimum cut-off values are considered, it is imperative to evaluate the diagnostic accuracy of the test. Ramadhani and colleagues almost did this when they constructed a receiver operating characteristic (ROC) curve (a plot of sensitivity against (1 – specificity) for each of a range of cut-off values), but they failed to calculate the area under this curve. It is the area under the ROC curve which determines the diagnostic accuracy. A “perfect” test is one whose ROC curve runs up the abscissa to a sensitivity value of 1, and then along a line parallel to the ordinate. The area under such a curve equals 1. A totally worthless test is one whose ROC curve runs along the line of identity. The area under such a curve equals 0.5.

I have calculated the area under the ROC curve of Ramadhani and colleagues to be approximately 0.71 (Simpson’s method). What is also missing from Ramadhani and colleagues’ data are the confidence intervals of these proportions taken from populations whose proportions are $p_{\text{true}}$ and $p_{\text{spec}}$. The standard errors of these sample proportions are given by:

$$\text{standard error} = \sqrt{\frac{p(1-p)}{n}}$$

where $p$ can be estimated from the sample proportion (i.e. the sample specificity or sensitivity).4

Figure 1 shows the ROC curve re-drawn from the authors’ data with the appropriate confidence intervals ($\pm 1.96 \times$ standard errors). These confidence intervals define the axes of the spindle shaped areas which contain the population data with 95% confidence. One such shape is shown for a sternal distance of 13.5 cm. If the lowest points of these spindles are plotted, this creates the ROC curve seen in figure 2. This represents a “worst-case” ROC, but is within the 99% confidence limits of the data. The ROC curve in figure 2 follows closely the line of identity. The area under such a curve equals 1. A totally worthless test is one whose ROC curve runs up the abscissa to a sensitivity value of 1, and then along a line parallel to the ordinate. The area under such a curve equals 1. A totally worthless test is one whose ROC curve runs along the line of identity. The area under such a curve equals 0.5.

Figure 1 Receiver operating characteristic (ROC) curve for sample data, with confidence intervals.

Figure 2 Modified receiver operating characteristic (ROC) curve with data points from extremes of confidence intervals. Broken line = line of identity.

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Sir,—Thank you for the opportunity to reply to Dr Farmery’s letter.

One of the statistical problems was to develop a rule, based on sternal distance, that could be used to discriminate between easy and difficult laryngoscopy. One way of doing this statistically is by performing discriminant analysis. In our study, a linear discriminant function, $f=10 \times$ SMD (sternal distance) was calculated using parametric methods (i.e. using a measure of generalized squared distances, based on covariance matrices, but also taking into account the prior probabilities of the groups). In order to use this function to allocate patients to one of two groups, we had to specify a cut-off point, such that a patient can be assigned to one group if his score exceeds this cut-off value and to the other group if it does not.1 It was shown that for a cut-off point of 13.5 cm the misclassification rate was minimized.

Although the ROC curve in this study was used mainly to illustrate the predictive properties of each of the cut-off levels, we
agree with Dr Farmery that the area under the curve would have been useful for assessing the diagnostic accuracy. Using the Trapezoidal method, we calculated the area under the ROC to be 0.71. The area under the “worst-case” ROC, as illustrated by Dr Farmery (i.e. plotting sensitivity−1 against 1−specificity), was calculated to be 0.596. (Note that the appropriate way to estimate confidence intervals for proportions is by p+−1/N−1, and not using the t distribution as suggested by Farmery.) Although this value is quite low, it should also be mentioned that the area for the “best-case” ROC (using sensitivity+1/N+1 against 1−specificity) was 0.828, which can be considered very good. Based on this interval, which clearly excludes an AUC of 0.5, we cannot, on statistical grounds, reject the measurement of 0.71 as a worthless predictor of difficult laryngoscopy. In addition, we would again like to reiterate the sternomental distance as a worthless predictor of difficult laryngoscopy. Given the premise that PORC still occurs commonly even with bolus doses or continuous infusions of a neuromuscular blocking agent is used. It is demonstrated repeatedly to produce good recovery after atracurium and vecuronium, provided the anticholinesterase is given before recovery from block is established, or if time is not allowed for the anticholinesterase to act, recovery may be inadequate on arrival in the recovery room. Obviously, there is a need for a large prospective study of PORC in patients who have been given varying doses of anticholinesterase at different degrees of recovery from block induced by varying neuromuscular blocking drugs. But the use of smaller doses of neostigmine has been demonstrated repeatedly to produce good recovery after atracurium and vecuronium, provided the anticholinesterase is not administered until 20% recovery of the first twitch of the train-of-four response. The time to full recovery after administration of neostigmine is longer than many anaesthetists realize, at least 7–10 min.13 I suspect we would agree that continuous neuromuscular monitoring is essential throughout anaesthesia and until tracheal extubation, whether or not an anticholinesterase is used. When an anticholinesterase is given, it should not be administered until recovery is well established (at least two twitches of the train-of-four response are present) for full recovery from block to be reliably obtained. This is particularly pertinent when repeated bolus doses or a continuous infusion of a neuromuscular blocking agent is used.

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Sirm,—Thank you for the opportunity to reply to Dr Favcett’s letter. As I expressed in my editorial,1 the need for caution when deciding not to use an anticholinesterase to antagonize residual neuromuscular block is paramount. This is particularly so if aminosteroids are used: I believe one should not consider omitting the anticholinesterase after these drugs. The increased incidence of residual curarization after the use of the longer acting agents, pancuronium and tubocurarine, is one reason to select atracurium or vecuronium, even for long surgical procedures. When using the benzylisoquinoliniums, I stressed the necessity to monitor neuromuscular block throughout anaesthesia if an anticholinesterase is to be omitted. The weakness of Dr favcett’s argument is that in his retrospective study,2 some of the patients were monitored for the first time in the recovery room. Even in the patients who were monitored peroperatively, the clinical practice of the anaesthetist, as much as the neuromuscular blocking drug, could be at fault in preventing full recovery from neuromuscular block before extubation. For instance, if recovery from block is so poor that an anticholinesterase is required before extubation, it may take a longer time to achieve a level of neuromuscular block that is acceptable.


Cutting paediatric tracheal tubes—a potential cause of morbidity

Sirm,—We wish to describe a critical incident that occurred at our institution recently. A child of 13 months required prompt tracheal intubation and ventilation as part of the management of acute meningitis. After induction of anaesthesia the trachea was intubated easily with a size 3.5 mm internal diameter tracheal tube, a single use Blue Line tracheal tube (SIMS Portex Ltd


Neuromuscular block in children

Sirm,—In her editorial, Dr Hunter states that anaesthetists should question if they are using too much neostigmine and suggests that a reduced dose of 1.25 mg may be preferable in adults.1 However, there is no mention of the incidence of postoperative residual curarization (PORC). While this is rare in children,2 PORC has been shown to occur in up to 48% of patients with agents such as pancuronium and curare.3,4 With the introduction of atracurium and vecuronium, the incidence of PORC is reduced, but it is still a significant problem. Myself and my colleagues recently demonstrated that PORC affects 12% of adult patients after a bolus of one of these two drugs and occurs in 24% after infusions.5 Moreover, we demonstrated that even those patients in whom a peripheral nerve stimulator was used during operation did not have a reduced incidence of PORC. Other workers have also shown PORC to occur in 9% of patients who had received vecuronium.6

Given the premise that PORC still occurs commonly even with intermediate acting non-depolarizing agents, I question the rationale and evidence for reducing the dose of neostigmine in adults. PORC may result in hyperventilation and inability to protect the airway, in addition to being subjectively unpleasant for conscious patients. Moreover, because side effects of neostigmine are relatively minor compared with the potential serious adverse sequelae of PORC, I would urge caution in reducing the standard dose of neostigmine until the safety of this has been confirmed.

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5. Favcett WJ, Dash A, Francis GA, Liban JB, Cashman JN.


Hythe, England) which had been cut to 14 cm immediately before use. Although the child’s lungs could be ventilated, a 4-French gauge endobronchial suction catheter could not be passed through the tube to aspirate pulmonary secretions. The tube was therefore changed. A Contour tracheal tube (Mallinckrodt Medical UK Ltd) of the same size, also cut immediately before use, was inserted in its place. On this occasion we were unable to ventilate the child’s lungs. It rapidly became apparent that this tube was completely occluded and it too was changed. This occurred uneventfully.

On subsequent detailed inspection it was discovered that both tubes had suffered the same complication (see figs 1, 2). The plastic 15-mm connector, while being inserted into the cut tube by an experienced operating department assistant (ODA), had buckled inwards occluding its distal lumen. This occlusion was very difficult to see from routine external inspection of either tube, which is why the problem was not detected when the equipment was checked rapidly before use by the anaesthetist and the ODA.

Portex Ltd and Mallinckrodt Medical are unaware of any previous description of this problem occurring in standard sized connectors and are investigating the respective tubes for manufacturing defects. A similar problem has been described only in 8.5-mm Minilink connectors for 3.0-mm and 4.0-mm Portex Blue Line tracheal tubes1 when the problem was blamed on excessive twisting during re-insertion of the connector.

In this case the clinical urgency of the situation resulted in the tubes being checked less thoroughly than normal, and probably also accounted for any excessive force that may have been used in re-inserting the connectors. It is therefore important to recognize that the situation could have been avoided entirely by using an un-cut tracheal tube. While texts on the management of paediatric emergencies still provide formulae for calculating the length to which tracheal tubes should be cut,2 we feel that in the emergency situation the practice of cutting tracheal tubes immediately before use should be discouraged. It not only takes longer but, as this incident demonstrates, is also a potential source of disaster.

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Lead by example

Sir,—I was recently unfortunate enough to require a general anaesthetic myself. I was admitted to a teaching hospital with a prolapsed intervertebral disc and was to undergo a microdiscectomy. As the second patient on the list, I was seen 30 min before going to theatre, by a first-year specialist registrar, who was in the first week of his neurosurgery attachment. He was uncertain of his supervising consultant’s proposed postoperative analgesia plans and was clearly intimidated in talking to another anaesthetist.

The consultant was still transferring the previous patient to recovery when I arrived in theatre and had asked the trainee to proceed. A dose of fentanyl was followed rapidly by thiopentone and a neuromuscular blocking agent, and the next thing I remember was a gagging sensation as the tracheal tube snagged on my arytenoid cartilages before entering the trachea. The combination of sensory input and no motor response was difficult to describe, but it was certainly unpleasant, and I am sure that for someone without any anaesthetic knowledge, would have been terrifying.

Despite mentioning this occurrence to the ward nurses after operation, I did not see an anaesthetist again before my discharge 2 days later. This experience has highlighted one or two areas of training that I feel need to be addressed.

Where trainees are with a consultant for a teaching list, it is not unreasonable for the trainee to be asked to see the patients for the remainder of the list, when the first patient is on the operating table. In many specialties, it is not possible to publish
a list the day before, as a major part of the workload may be emergencies. However, if a trainee is sent to see patients, it is vital that they know what the consultant is proposing to do, and how it is to be undertaken. Consent for anaesthetic must be as informed as consent for surgery. Detailed explanations of the anaesthetic procedures and their associated risks must be provided. If the consultant does not provide sufficient information, the trainee should seek further clarification before seeing the patient. If trainees do not feel confident that they can explain the procedure adequately to the patient or are not aware of the potential complications of the procedure to be undertaken, they should request a joint visit with the consultant to see how the explanation should be given. In these litigious days, uninformed consent can be the basis for many legal actions. Very few trainees ever see consultants inform their patients about anaesthetic procedures, risks or complications, and this is an area which could be improved.

My second point concerns the practice of postoperative visits by anaesthetists. As a trainee, I was taught that the list had not finished until patients had been reviewed on the ward after their operations. Sadly, postoperative visits to NHS patients are becoming less common. A recent survey in Bath revealed that only 14% of NHS patients were seen on the ward after operation by an anaesthetist, even though the proportion approached 90% in the private sector. The main reason cited for this was that sessions funded for postoperative visiting in the NHS were being taken up by other clinical and administrative duties, whereas in the private cases, a postoperative visit resulted in an additional payment.

Trainees pick up the habits of their trainers. If they see consultants neglecting their responsibilities, and not visiting patients after the list has finished, or the following day, it is not surprising that postoperative visits are becoming a thing of the past, with very little perceived value to managers. If the present trend continues, will preoperative visits be the next victim?

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CHANGE IN EDITORIAL ARRANGEMENTS

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