recommended today for straight blade insertion. Neither is it the usual positioning for the curved blade, intended to be inserted into the vallecula epiglottis (a measurable distance from the hyoid).

We have also used radiologic methods to evaluate the airway¹ and cannot concur that the hyoid is directly engaged. The hyoepiglottic fascia and muscle is stretched by placement of the curved laryngoscope tip. Thus, the *apparent* downward and forward displacement of the hyoid bone is a radiological and anatomical error as proven by fluoroscopic multi-positional views. The motion of the hyoid is the result of the anterior/posterior digastric muscle passing through a fascial pulley on the body of the hyoid in counter position to the stylohyoid muscle – *secondary to temporomandibular coronoid process (TMJ) translocation at the articular eminence of the zygoma*. The countervailing force is produced by the caudad stretching of the laryngotrachea translated from the weight of the lungs and their fluid content. This biomechanical process is best seen in the sitting position.

I wholeheartedly encourage and congratulate your biomechanical analysis of blade construction. I also submit that a reconsideration of the analysis should include the above factors and that the fact that radiological views often also produce spatial distortion.

Martin L. Norton MD JD
Department of Anesthesiology
University Hospital
1500 East Medical Center Drive
1G323UH Box 0048
Ann Arbor, MI 48109

REFERENCES

- 1 Norton MC, Brown Atlas of the Difficult Airway. Radiologic Techniques. Chicago Year Book Medical Publisher, 1991.

REPLY

We are grateful to Professor Norton for his supporting comments about the merit of our theoretical analysis of blade shape and its relevance to clinical practice. Obviously we concede that we decided to compare 'like with like' by not taking into account all the differences in the way that curved and straight blades are used in practice. We concluded that all blades have an "effective width" which depends firstly on blade shape and secondly on the space required for its appropriate positioning. To make the latter comparable we took our observed normal position of the curved blade during x-ray laryngoscopy¹ as the basis for comparison.

This appears to be where Professor Norton and we disagree. The relevance of the hyoid was shown in our study of normal volunteers where a view at laryngoscopy with the curved blade was only possible when the blade contacted the hyoid. This directly contradicts his assertion that the curved blade is "intended to be inserted into the vallecula epiglottis (a measurable

distance from the hyoid)." When the blade tip did not descend far enough to make contact with the hyoid, forward traction with the laryngoscope resulted in the blade tip simply becoming enveloped in tongue tissue. Despite traditional teaching to the contrary, this study also showed that stretching of the hyoepiglottic ligament is not essential for lifting the epiglottis forward. When the blade was positioned above the hyoid (i.e., at the insertion of the muscle bulk into the greater cornua) and immediately adjacent to it, the epiglottis could be pulled forward passively without the hyoepiglottic ligament being distorted. Naturally this should not be expected on its own to be sufficiently effective in every case, especially when the hyoepiglottic ligament is unduly long.

Work currently in progress demonstrates that once the position of the hyoid is identified and the curved blade is kept close to the tongue as it is moved towards the velliculum, visualisation (by an illuminated laryngeal mirror) confirms the importance of contact with and traction on the hyoid, as well as indentation of the hyoepiglottic ligament. We believe that our differences with regard to "apparent downward and forward displacement of the hyoid" are because our x-ray laryngoscopy studies relate to the changes resulting from the act of laryngoscopy. The reason the hyoid is moved downwards and forwards is because part of the tongue is pushed down into the pharynx and then subsequently pulled forwards by the laryngoscope blade. This is also apparent if laryngoscopy in progress is observed and palpated from the side of the neck. Our x-ray studies of difficult intubation patients also explain what happens when the blade tip fails to make contact with the hyoid and why this limits the view obtained.^{2,3} Observed normal hyoid movement was obvious because a standardised intubation position⁴ was employed to compare with a database of 50 similarly positioned controls. Finally, calcification of the stylohyoid ligaments is an accepted cause of difficult intubation² and there is no reason to believe that this would interfere with indentation of the hyoepiglottic ligament though it can obviously limit hyoid mobility.

With regard to differences in the use of the two blade types, provided blades are compared in similar circumstances, this is all that is required. Our analysis described blades as resting on the upper incisors, and used the tip of the incisors as the upper reference point. They were then considered rotated forward according to the space available behind the mandible. Professor Norton's book implies that the straight blade should be positioned on the right side of the mouth rather than in the midline. The curved blade could be considered to be similarly positioned and appropriate allowance made in the model. The new upper reference point, would then need to be the point nearest the upper teeth about which the blade could again be considered to be rotated forward. The angle MIT, or "forward space angle" of our analysis would be changed but likely to affect both blades similarly. Positioning in front of or behind the epiglottis is also unimportant provided the same consideration applies to each blade type. Curved blade placement below the epiglottis is considered by many anaesthetists to be the obvious way to deal with a long floppy epiglottis. The fact that clinicians are content with less than a full view of the cords should not carry much weight when comparing relative blade efficiency.

P. Charters
R.R.D. Marks
Aintree Hospitals
Liverpool, UK.

REFERENCES

- 1 Horton WA, Fahy L, Charters P. Disposition of cervical vertebrae, atlanto-axial joint, hyoid and mandible during x-ray laryngoscopy. *Br J Anaesth* 1989; 63: 435-8.
- 2 Horton WA, Fahy L, Charters P. Factor analysis in difficult tracheal intubation: laryngoscopy-induced airway obstruction. *Br J Anaesth* 1990; 65: 801-5.
- 3 Fahy L, Horton WA, Charters P. Factor analysis in patients with a history of failed tracheal intubation during pregnancy. *Br J Anaesth* 1990; 65: 813-5.
- 4 Horton WA, Fahy L, Charters P. Defining a standard intubating position using "angle finder." *Br J Anaesth* 1989; 62: 6-12.

The cost of anaesthesia

To the Editor:

The cost of anaesthetic care is of considerable interest.¹⁻³ Hospital funding has been scrutinized increasingly by governments as they seek to limit expenditures. These pressures may result in departments being asked to develop new methods of budget management. We were recently asked to develop a case-based system of costing.

Funding provided to anaesthesia departments commonly falls into distinct budget categories, for example, Pharmacy, Human Resources, Supplies, and Service Contracts. While this information is useful for tracking costs, it does not provide a budget based directly on patient care activity. We wanted to determine whether a simple prospective measurement of cost limited to a few major procedure types could predict our department budget for pharmaceuticals and supplies. Neither capital equipment nor labour costs were included.

A detailed worksheet was developed to allow a data entry clerk to record all drugs and supplies used by anaesthetists while providing care. Data were obtained from a limited number (ranging from one to six) of arbitrarily chosen procedures from each of ten different surgical specialties. In all 36 cases were assessed between July 1 and August 13, 1993. Actual costs of individual items were obtained from the hospital's materials and pharmacy departments.

Once average subspecialty case costs were determined, the overall pharmacy and supplies cost was calculated from the known case distribution (available from the operating room information system) and then compared with the actual cost as reported by the hospital's finance department. The period chosen for the calculation was from January 1 to June 30, 1993. The results are shown

TABLE Calculation of overall cost

	# Cases/ period	Av. cost/ case \$	Total \$
General procedures (cardiac cath, angiography)	517	22	11,374
Anaesthesia (epidural for pain control, nerve block, dental)	45	25	1,125
Obstetrics (therapeutic abortion, ectopic pregnancy)	1049	24	25,112
Gynaecology	815	48	39,120
Thoracic and vascular	200	204	40,800
General surgery	1254	57	71,478
Orthopaedic	1136	54	61,344
Neurosurgery	340	164	55,760
Urologic	1025	34	34,850
ENT	545	90	49,050
Ophthalmology	918	5	4,590
Reconstructive plastics	388	98	38,024
Psychiatry	246	10	2,460
Unknown classification	55	?	?
Total	8854		\$414,567

in the Table. Similar data sheets were recorded for six cardiac surgical cases (a separate budget at Foothills Hospital).

The total predicted budget using the model was \$414,576; the corresponding actual expenditures reported by the hospital finance department were \$410,158. The six cases assessed from the cardiac surgical area had a mean cost of \$936.61, compared with an actual expenditure of \$1135.37. Prediction of the cardiac budget would have resulted in a 20% underestimation.

This is an attempt to develop an assessment of costing that is not related to resource inputs, for example, human resource and pharmacy budgets, but to the actual service provided. It is clearly preliminary in nature. It may well be that the degree of agreement between the actual and predicted budgets was entirely fortuitous. For example, the model would fail to predict reliably the actual cost of cardiac anaesthesia, due to their wide cost variation (approximately three-fold). While it may be possible to overcome these difficulties with more sophisticated models which allow greater stratification of cases, smaller programmes may not find this method useful. We plan to repeat this process for a subsequent six-month period; however, we are interested in any experience other departments have in this area.

C.J. Eagle MD FRCP
Shellie Kryski BSc
Department of Anaesthesia
Foothills Hospital
Calgary, Alberta T2N 2T9