Annals of the Royal College of Surgeons of England (1993) *vol.* 75, 175–177

Comparative vascular audit using the POSSUM scoring system

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Key words: Vascular surgery; Surgical audit

Comparative audit using overall mortality and morbidity figures can be misleading as they do not take into account variations in surgical procedure and patient fitness. To examine these effects we have compared vascular surgery in two differing hospitals, during a similar 9-month period, using the POSSUM scoring system. In one unit, 255 patients underwent vascular surgery with an operative mortality of 9.4%, and morbidity of 37.3%. In the other unit, 89 patients underwent vascular procedures with an operative mortality of 20.2% and morbidity of 47.2%. At first sight there appear to be significant differences in operative outcome between the two units. However, analysis using the POSSUM system predicts a mortality rate of 10.2% for unit A and 20.2% for unit B (morbidity rates of 38.4% for unit A and 50.6% for unit B). Receiver operating curve (ROC) analysis demonstrated no significant difference between the two units (see Table III). POSSUM analysis may be of use in comparative audit.

Comparing the outcome of operations between different surgical units can be difficult, particularly in vascular surgery. The use of crude mortality and morbidity rates to compare surgical performance can be misleading, as they take no account of variation in case mix, surgical practice and physiological status at the time of operation.

We have recently devised and validated a scoring system, POSSUM (*P*hysiological and *O*perative *S*everity *S*core for the en*U*meration of *M*ortality and morbidity), which enables an accurate assessment of mortality and morbidity to be made across the spectrum of general surgical operations, including vascular procedures *(1)*.

Our aim in the present study was to use the POSSUM scoring system to perform a quantitative comparison of the outcome of vascular surgery in two different vascular units.

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Methods

All patients admitted for consecutive vascular reconstructive surgery during a similar 9-month period at Broadgreen and Walton Hospitals, Liverpool, were scored using the POSSUM system. Broadgreen and Walton Hospitals are both teaching hospitals near to the city centre (Units A and B). The former has a specialist vascular unit taking a high percentage of tertiary referrals. Walton Hospital has two general surgeons with a major interest in vascular surgery, but takes few tertiary referrals.

During this period 255 patients in unit A and 89 patients in unit B underwent reconstructive vascular procedures. Patients undergoing percutaneous transluminal angioplasty or lumbar sympathectomy have not been included. All patients surviving surgery were reviewed at 6 weeks to check for any delayed complications.

All patients were scored before operation (using the physiological score) and at discharge (using the operative severity score). All score details were obtained from all subjects with the exception of a chest radiograph (which

was obtained in 95.9% of patients). Complications were defined in accordance with our previous studies (*1*).

In unit A, 255 patients underwent vascular surgery with an operative mortality of 9.4% and morbidity of 37.3%. In unit B, 89 patients underwent vascular surgery and had an operative mortality of 20.2% and morbidity of 47.2%. Using such crude mortality and morbidity figures there would appear to be significant differences between the two units with regard to mortality ($P<0.01$; χ^2 statistic), although the differences in morbidity did not reach significant levels. However, such data does not represent either the physiological status of the patient at the time of surgery, or the type of surgery performed.

Scoring using the POSSUM system yields an estimate of physiological status (physiological score) and operative severity (operative severity score). Analysis of the physiological and operative severity scores of the patients operated on in the two units revealed quite different patient score profiles. In unit A there was a greater proportion of patients with lower score values in both physiological and operative severity score (Table I, Table II).

Combining both elements of the POSSUM system yielded an assessment of mortality and morbidity. Using such an analysis produced estimated mortality rates of 10.2% for unit A (observed 9.4%) and 20.2% for unit B (observed 20.2%). The predicted morbidity rates were 38.4% for unit A (observed 37.3%) and 50.6% for unit B (observed 47.2%). As can be seen, these predicted estimates are not dissimilar from the observed rates. In addition, receiver operating curve (ROC curve) analysis revealed no significant difference between the two groups (Table III; Fig. 1, Fig. 2) with regard to mortality or morbidity.

Discussion

Surgical audit has greatly increased in importance over the past two decades. While estimates of the quantity of surgical care are fairly easy to obtain, and indeed compare with other units, estimation of the 'quality of care' is more difficult. In this regard the use of crude mortality and morbidity rates to compare surgical performance between different units can be misleading. While we

Table I. Distribution of patients within each score range (physiological element of the POSSUM score); an increase in score value indicates an increasing degree of preoperative physiological disturbance. The score consists of 12 physiological variables: age, cardiac status, respiratory status, systolic blood pressure, pulse, coma score, urea, potassium, sodium, haemoglobin, white cell count and electrocardiogram. Each variable is divided into four grades, allocated scores of 1, 2, 4 or 8)

Score range	*Unit A*	*Unit B*
12–19	49.0%	32.6%
20–27	34.5%	37.1%
28–35	13.3%	12.4%
36–43	2.7%	9.0%
44–51	0.4%	3.4%
> 52	0%	5.6%

Table II. Distribution of patients within each score range (operative severity element of the POSSUM score; an increasing score value indicates an increasing degree of operative severity. The score consist of six variables: type of procedure, number of procedures, blood loss, peritoneal contamination, presence and extent of malignancy, timing of operation. Each variable is divided into four grades, allocated scores of 1, 2, 4 or 8)

Score range	*Unit A*	*Unit B*
6–9	19.2%	13.5%
10–13	25.9%	31.5%
14–17	22.7%	16.9%
18–21	18.0%	7.9%
22–25	4.3%	11.2%
26–29	1.6%	9.0%
30–33	0.8%	5.6%
>34	5.5%	4.5%

Table III. Receiver operating characteristic (ROC) curve data for units A and B. There is no significant difference between the two curves with regard to mortality or morbidity

	Mortality		*Morbidity*	
	A	*B*	*A*	*B*
Area under ROC curve	0.878	0.918	0.756	0.795
Standard error	0.046	0.042	0.033	0.048

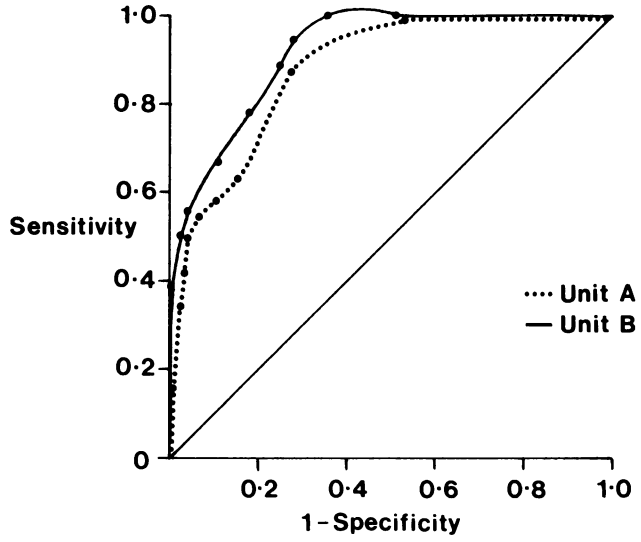

Figure 1. Receiver operating characteristic (ROC) curves for mortality. There was no significant difference in areas under the ROC curves between the two units.

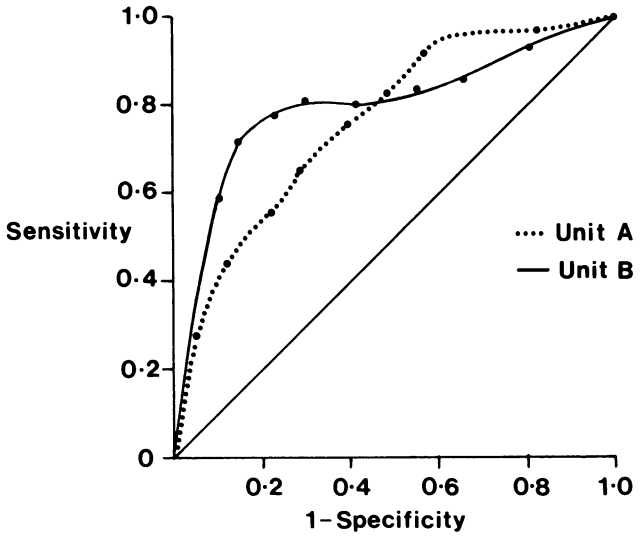

Figure 2. Receiver operating characteristics (ROC) curves for morbidity. There was no significant difference in areas under the ROC curves between the two units.

would all recognise that variations in case mix, surgical practice and physiological status of the patient must affect the outcome of operation, analysis of these variables would have been difficult until recently.

Scoring systems assessing physiological status and disease severity would seem to answer some of these needs. One of the most widely used scoring systems, particularly in North America, is APACHE II (*2,3*). This has not been found to be especially helpful in the surgical setting (*4,5*). The POSSUM system has been designed specifically for audit purposes in the general surgical patient, and produces an accurate estimate of morbidity as well as mortality. In addition, POSSUM has been validated in patients undergoing vascular surgery, and has been shown to be superior to APACHE II in the high-dependency surgical unit setting (*6*).

The present study demonstrates how misleading crude mortality and morbidity figures can be when comparing different units. By producing a single assessment of physiological status at the time of operation and operative severity (this assesses elements of both case mix and surgical practice), POSSUM analysis allows a more realistic comparison between units.

The present study confirms the accuracy of POSSUM in predicting both mortality and morbidity. In addition, it demonstrates that POSSUM can be applied to comparative audit, at least in vascular surgery. As POSSUM was designed to be applicable across the general surgical spectrum, and has been validated in gastrointestinal, hepatobiliary and urological surgery as well as vascular surgery (*1*), it is likely that it can be applied to comparative audit in other general surgical subspecialties.

Further studies are in progress across the Mersey Region under the direction of the Mersey Region Surgical Research Group, to compare a greater number of units in a range of general surgical subspecialties. In vascular surgery in particular, we are combining POSSUM analysis with our recently developed scoring system to assess the risk of graft occlusion (GORA) for audit purposes.

We wish to thank the surgeons at Walton and Broadgreen Hospitals for allowing us to use details of patients admitted under their care. This research was conducted under the direction of the Mersey Region Surgical Research Group.

This study was presented to the Vascular Surgical Society of Great Britain and Ireland in 1991.

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Received 21 August 1992