The small standard deviations in table III support the view[3] that patients with the same ISS have sustained injuries of equal severity.

Discussion

Our initial experience with the use of the ISS technique has been very encouraging, both in epidemiological[9] and metabolic studies. The plasma cortisol concentration is a sensitive measure of severity, and the difference in its concentration in the groups of patients with ISS values of 4 and 9 confirms that there was a real difference in the severity of their injuries. The use of the ISS method in further metabolic studies will be reported later.

Injury severity scoring can be done by an inexperienced person without error as the categories in the AIS list are sufficiently broad to cover minor variations in the injuries. It may seem remarkable that any worthwhile scale for the severity of injuries can be obtained by reading numbers out of a book but such is the case. The "trick," if it can be called that, lies in squaring the AIS values for the three areas with the most severe injuries before adding to obtain the ISS value, but this gives the best correlation between severity and mortality.[3]

At first sight there are some anomalies. The ISS value for a patient with a fracture of one femur could be the same as that for a patient with fractures of both femurs and the pelvis. Except for penetrating injuries the ISS values seem to be related to the amount of force needed to cause the injuries. The great force needed to produce such injuries would almost certainly have damaged other regions and so raised the score. Anomalies of this kind were not found in our patients and the ISS values seemed to reflect the clinical severity of their injuries correctly. Nevertheless, the detailed correlation between severity and biochemical changes on which we are engaged may suggest refinements of the ISS technique. Penetrating injuries—for example, stab wounds—may provide exceptions[3] and the use of the method for such injuries and for elective surgical operations has not yet been explored.

Quite apart from its research value the ISS method has clinical uses. Discrepancies between the proposed ISS value and the clinical appearance of the patient may be useful in drawing attention to errors in the diagnosis. Similarly the building up of a high score from a number of injuries, individually classed as minor, may draw the attention of the inexperienced clinician to the greater needs of the patient—for example, for transfusion. It must, however, be emphasised that the ISS is not intended as a prognostic index and should not be used as such. Other techniques have been proposed for this.[13]

We thank Dr G S Laing, consultant in emergency medicine, for giving us access to the patients under his care; the medical and nursing staff of the Hope Hospital accident and emergency department for their help; and Mr B Passingham for his technical help.

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(*Accepted 13 September 1977*)

Airway patency in fatal accidents

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British Medical Journal, 1977, **2**, 1249-1251

Summary

The state of the airway in patients who had fatal accidents over a five-year period was correlated with the severity of injury sustained. Necropsy of patients dying in hospital up to 72 hours after an accident showed that those with obstruction of the airway had less severe injuries than those in whom no such obstruction could be found. This suggests that airway obstruction contributed to their death. A similar distinction could not be shown for the patients who died before they reached hospital, indicating that airway management before arrival at hospital was probably satisfactory.

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Introduction

Many accident victims die before they reach hospital, and it is generally believed that fewer would do so if some medical expertise were available before and during the ambulance journey. In particular, it is thought that skilled management of airway obstruction would prevent many deaths in transit.[1] It has never been easy to evaluate the effectiveness of prehospital treatment, mainly because of the difficulty of comparing patients presenting with a wide variety of injuries. In an accompanying paper Stoner *et al*[2] describe the injury severity score (ISS) developed by Baker *et al*,[3] which appears to overcome this problem. Described here is the application of the ISS in assessing one aspect of patient care—the management of the airway in the victims of fatal trauma.

Method

All deaths reported to the coroner in the Salford area over a five-year period were reviewed. With the permission of the coroner 6095 necropsy reports were examined, and those relating to road traffic accidents, industrial and home accidents, assaults, and suicides involving violence were extracted.

Those dying at the scene of the accident or en route to hospital were distinguished from those dying in hospital within 72 hours. Later deaths were excluded.

The patency of the airway was unequivocally stated in all but seven of the necropsy reports, allowing subdivision of the patients in each group according to whether their airways were clear or obstructed (table I). The remaining seven were allocated randomly. Those with obstructed airways were those for whom the pathologist had indicated in his report that a significant amount of blood, vomit, or other material was present in the upper respiratory tract.

Each case was assigned an ISS based on interpretation of the necropsy report but ignoring any reference in it to airway obstruction. Bull[4] has shown that the relationship between mortality and ISS varies with age. By using his probit lines extended as shown in fig 1 the scores of patients under 45 and 65 and over were all converted to scores appropriated to the 45-64 age group. For example, a patient aged 70 with an ISS of 30 had an age-corrected score of 40.

TABLE I—*Fatal accidents in the Salford Area 1971-5*

	Died at scene		Died in hospital within 72 hours	
	Airway clear	Airway obstructed	Airway clear	Airway obstructed
Road traffic accidents	15	19	38	41
Industrial accidents	2	5	4	6
Home accidents	4	6	6	8
Railway accidents, violent suicides, and assaults	10	8	–	2
Total	31	38	48	57

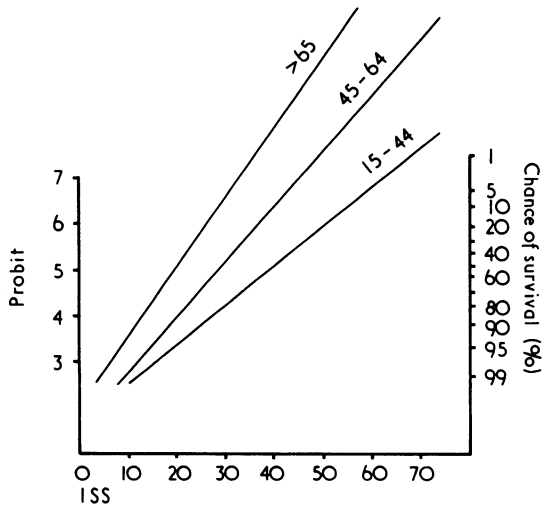

FIG 1—Relation between ISS and survival (modified from Bull[4]). Probit lines have been extended to allow translation of scores for younger and older age groups on to the line representing middle age group.

Results

The age-corrected scores of all cases in the four groups are shown in fig 2. Fig 3 shows the cumulative mortality of each of these groups plotted against the ISS. "Mortality ratio" is normally used when constructing such curves, but the lack of adequate retrieval facilities for the notes of the survivors prevented investigation of the survivors and compelled the use of the less satisfactory "cumulative mortality."

Patients were ascribed injury scores according to the injuries they sustained, without reference to the state of the airway. An obstructed airway may be contributory or incidental to death. An incidental relationship would result in identical mortality-ISS curves for the obstructed and clear groups. If, however, an obstructed airway contributed to death the curve for the obstructed group would shift to the left because the greater the contribution an obstructed airway makes to the death of a patient the less severe the non-respiratory injury needed to kill him.

The results show that in the higher score range the group of patients with obstructed airways was shifted slightly to the right; but in the important lower score range, where the injuries sustained were not automatically lethal, the reverse was true.

The significance of this shift to the left was analysed as follows. Subgroups were formed of the same percentage of patients in each group (obstructed and clear), these patients being those with the lowest scores. The actual scores within these subgroups were then compared using Wilcoxon's rank sum test[5] (table II). When the 30% least injured in each group were compared there was no significant difference but when the 20% least injured patients were examined

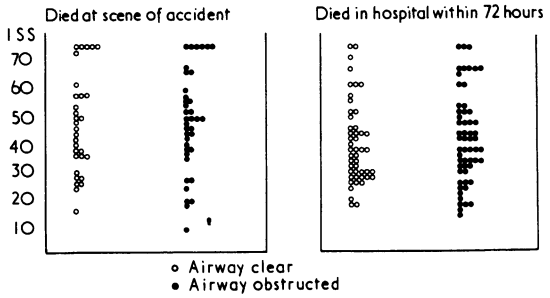

FIG 2—Age-corrected injury severity scores of patients reviewed.

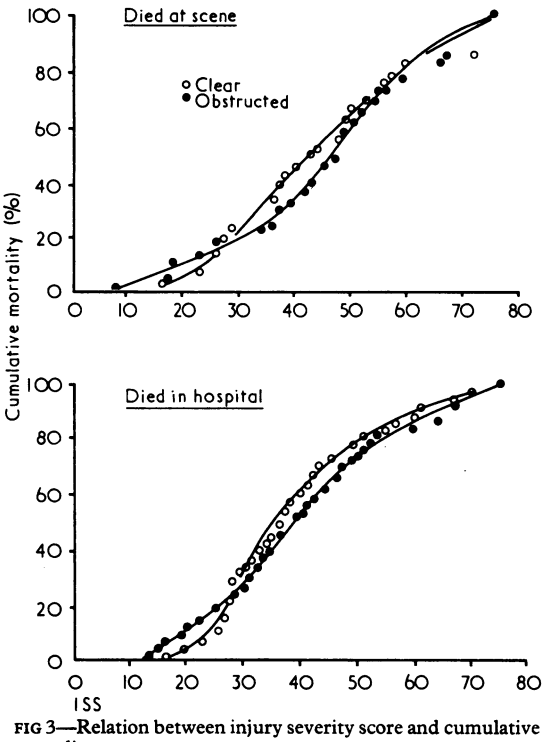

FIG 3—Relation between injury severity score and cumulative mortality.

TABLE II—*Analysis of difference between clear and obstructed airway groups in those dying with low ISSs*

Patient's scores	Airway	No of patients who:		Probability of non-respiratory injuries being less severe in obstructed group	
		Died at scene	Died in hospital	Died at scene	Died in hospital
Lowest 30%	Clear	9	15	NS	NS
	Obstructed	12	17		
Lowest 20%	Clear	6	10	NS	P>0·99
	Obstructed	8	11		
Lowest 10%	Clear	3	5	NS	P>0·95
	Obstructed	4	6		

NS = Not significant.

those dying in hospital with obstructed airways had less severe non-respiratory injuries than those dying with clear airways. The same tendency could be discerned when the lowest 10% were considered, although the numbers of patients were very small. These results suggest strongly that airway obstruction contributes to the death of some patients in the first 72 hours of hospital care. They do not indict airway management in those who die before they reach hospital.

Discussion

This study is presented as much for its method as for its results. The introduction of the ISS will do much to help to measure performance that has hitherto been the subject of speculation. Improvement in the data retrieval systems available to accident units is, however, essential if full use is to be made of auditing techniques. Because no retrieval system was available this work was based on cumulative mortality rather than the much more satisfactory concept of mortality ratio. It follows that no observations could be made on the undoubtedly important role of airway management in the survivors.

The policy adopted for the prehospital care of accident victims remained constant throughout the five years under review (1971-5). Ambulance crews were trained in basic resuscitation techniques and called out hospital staff only to care for trapped patients. The results would suggest that this quality of care is optimum with regard to airway management and that no improvement in survival could be expected if more advanced training were introduced. In contrast, airway management during the first 72 hours in hospital does not appear to be satisfactory.

These conclusions support the views of Hoffman,[6] who suggested that more deaths could be prevented in hospital than at the roadside. More recently Rose *et al*[7] have shown that a significant number of patients with head injury are dying unnecessarily in hospital. The work reported here has been concerned with only one aspect of the initial care of patients injured in an urban area. Outside the large conurbations more emphasis on prehospital treatment may be required because of the long distances involved. Such treatment will include the management of hypovolaemic shock and chest injuries, which were outside the scope of this review. All these aspects of initial care could and should be subjected to audit as methods for this are now available.

I thank Dr H B Stoner, Dr D F Heath, and Professor M H Irving for advice and Mr D Blakey, HM Coroner for Greater Manchester County (West), for permission to examine the necropsy reports.

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(*Accepted 13 September 1977*)

Increased plasma adrenaline concentrations in benign essential hypertension

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British Medical Journal, 1977, **2**, 1251-1254

Summary

Plasma adrenaline, noradrenaline, and dopamine concentrations and plasma renin activity were measured in the supine position and after standing for 10 minutes in 14 patients with sustained benign essential hypertension and in five patients with labile hypertension. Results were compared with values obtained in 11 normotensive control subjects. In controls plasma noradrenaline concentrations increased with age, while plasma adrenaline values tended to decrease with age. No significant difference in mean plasma noradrenaline was found between hypertensive and control subjects, but plasma noradrenaline seemed slightly increased in a proportion of hypertensive patients aged less than 50.

Plasma adrenaline was considerably raised in both supine and standing positions in eight patients with sustained hypertension and in two with labile hypertension. Dopamine concentrations and plasma renin activity were similar in all groups studied. The finding of significantly raised plasma adrenaline concentrations in a large proportion of hypertensive patients supports the hypothesis that the activity of the sympathetic nervous system is increased in essential hypertension. Measurement of plasma adrenaline seems to be a more sensitive index of this activity than that of plasma noradrenaline.

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Introduction

The role of the sympathetic nervous system and the adrenal medulla in the pathogenesis of hypertension was first suspected many years ago when the effects of noradrenaline and adrenaline on stimulating contraction of vascular smooth muscle and accelerating the cardiac contraction rate were discovered. Doubt was cast on this hypothesis, however, by the inconsistency of early attempts to relate hypertension to abnormal