PAPERS

Effects of London helicopter emergency medical service on survival after trauma

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Abstract

Objective—To assess the effect of the London helicopter emergency medical service on survival after trauma.

Design—Prospective comparison of outcomes in cohorts of seriously injured patients attended by the helicopter and attended by London ambulance service land ambulances crewed by paramedics.

Setting—Greater London.

Subjects—337 patients attended by helicopter and 466 patients attended by ambulance who sustained traumatic injuries and died, stayed in hospital three or more nights, or had other evidence of severe injury and who were taken to any one of 20 primary receiving hospitals.

Main outcome measure—Survival at six months after the incident.

Results—After differences in the nature and severity of the injuries in the two cohorts were accounted for the estimated survival rates were the same (relative risk of death with helicopter=1·0; 95% confidence interval 0·7 to 1·4). An analysis with trauma and injury severity scores (TRISS) found 16% more deaths than predicted in the helicopter cohort but only 2% more in the ambulance cohort. There was no evidence of a difference in survival for patients with head injury but a little evidence that patients with major trauma (injury severity score ≥16) were more likely to survive if attended by the helicopter. An estimated 13 (−5 to 39) extra patients with major trauma could survive each year if attended by the helicopter.

Conclusion—Any benefit in survival is restricted to patients with very severe injuries and amounts to an estimated one additional survivor of major trauma each month. Over all the helicopter caseload, however, there is no evidence that it improves the chance of survival in trauma.

Introduction

The first helicopter ambulance service in the United Kingdom started in 1987 in Cornwall. Since then 10 such services have started operations, and one major development, in April 1993, has seen the upgrading of the Scottish air ambulance service into a fully integrated aeromedical service which has three dedicated helicopters as well as fixed wing aircraft. The London helicopter emergency medical service started operations in May 1989 in the middle of this period of development.

The air ambulance services operating in the United Kingdom bear little resemblance to one another. The helicopters used and their ownership, crews, funding, operators, operational basis, and operating environment show such diversity that questions need to be raised about the appropriateness and cost effectiveness of the services.

This report is concerned with the London service. The London helicopter is an Aerospatiale Dauphin SA 365N crewed by two pilots, a registrar grade doctor, and a London ambulance service paramedic and can carry two stretchers. It operates from the Royal London Hospital during daylight hours. The helicopter is targeted for use in trauma emergencies and is called out via the ambulance service control centre. During all operating hours one of the paramedics on the helicopter rota is based in ambulance service control, identifying calls suitable for helicopter attendance. The paramedic sifts through all emergency calls that come into the control. Trauma calls are identified, and the paramedic tries to establish the condition of the patient before activating the helicopter so that abortive missions are minimised. Typical signs looked for as an indication that the helicopter is required are falls of over 2 m; road traffic accidents where a patient is trapped; injured patient reported as unconscious, not breathing, or with a threatened limb or burns; patient under a train; and confirmed gunshot or stabbing. Most calls are from within the ambulance service's operational area, which covers most of Greater London, although the adjoining ambulance services can and occasionally do request the attendance of the helicopter at incidents in the surrounding counties.

We have assessed the effectiveness of the London helicopter by comparing the outcomes of patients attended by a member of the helicopter team with those of patients attended by paramedically crewed land ambulances. The effect of the helicopter may result from several factors which it can bring to the scene of an incident over and above that offered by a ground ambulance crewed by paramedics. Firstly, medical attention can be given at the scene. There are several procedures, such as administration of paralysing, sedating, and painkilling drugs, and invasive procedures, such as chest decompression or cricothyroidotomy, which ambulance paramedics were not qualified to perform during this study. Secondly, the helicopter registrar can triage the patient to an appropriate receiving hospital, such as one with neurosurgery facilities for a patient with head injury. Thirdly, the speed of the helicopter means that potentially the scene of an incident or the destination hospital could be reached more quickly.

The effects of the helicopter have been set alongside estimates of the total marginal costs and cost consequences so that the health service, purchasers and providers, and the public can assess the value of the service. In this report we assess the effects of the London helicopter on survival after trauma.

Methods

STUDY PERIODS

The operation of the London helicopter has been studied during the two years from 1 August 1991

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to 31 July 1993. The helicopter was based at the Royal London Hospital and was operational during daylight hours, seven days a week. During this period there were no substantial changes in operational policy.

All the activity during this period was recorded. The evaluation started late, however, because of operational difficulties and the requirement to complete the study by the agreed date. So for the assessment of outcomes, which took place six months after the incident, only those patients attended during the first 21 months were followed up.

INCLUSION CRITERIA

Patients attended by helicopter

The activity evaluated was identified from the records which were completed by ambulance service control and the helicopter staff. The activity relates to all primary missions when the helicopter responded to a call to the scene of an incident (that is, excluding interhospital transfers) which resulted in a patient being attended by a member of the team. When the helicopter attends an incident patients may be carried to hospital by the helicopter (helicopter transfer); taken to hospital by land ambulance with a member of the helicopter crew in attendance (ground escort); or taken by land ambulance without a helicopter escort (ground assist). All three types of mission are included in this analysis as helicopter cases.

Patients meeting operational and clinical criteria for inclusion (box) and who were taken to any one of 20 primary receiving hospitals in the operational area of the London ambulance service were eligible to be included in the follow up, which used information from all available sources including pre-hospital records, records from accident and emergency departments, inpatient notes from both the primary receiving hospital and any subsequent hospital to which the patient was transferred, coroners' records, and, for a sample of survivors, an assessment of outcomes by interview or postal questionnaire. The hospitals were chosen at the end of a three month pilot study if they had received helicopter cases and were geographically dispersed throughout the whole of the region served by the ambulance service.

Patients who died at the scene were excluded only if no resuscitation was attempted. All other patients who died at the scene were eligible for entry into the study if they were taken to one of the 20 study hospitals. Some helicopter patients who died at the scene despite attempted resuscitation, however, were pronounced dead at the scene by the helicopter registrar and were taken directly to a mortuary. These patients were included in the comparisons only if they would have been taken to one of the 20 study hospitals had they been attended by land ambulance, according to a survey of hospitals used by the ambulance service.[1]

To bring the numbers of ambulance and helicopter patients in the study roughly into balance a sample of helicopter patients attended throughout the study period was chosen. The sample was stratified to increase the power of some comparisons which were made with the ambulance patients to separate out the effects of the care provided by the helicopter service before arrival at hospital and the effects of the hospitals to which patients were taken.[2] The stratified sample consisted of one in three helicopter patients flown to the Royal London and all other helicopter patients taken to the 20 study hospitals. In this report, however, a pragmatic approach has been taken and the receiving hospitals used by the helicopter have been considered as an integral part of the service. The stratified sample had therefore been weighted and combined to provide unbiased estimates for the whole caseload taken to the study hospitals irrespective of receiving hospital.

Control cohort attended by land ambulance only

The missions undertaken by land ambulances during the same 21 months relate to all patients with trauma attended by ambulance paramedics who were trained in the extended skills of intubation and infusion, for whom extended skills were used, and who arrived at hospital between 0800 and 2100. These hours were included to compare with the daylight only operation of the helicopter. All patients were followed up as for helicopter patients if they met the same criteria for inclusion and were taken to one of the 20 study hospitals.

In the pilot study we found that extended skills are rarely used by paramedics on children or in cases of isolated head injury, but such cases were found to form an important part of the helicopter caseload. We therefore examined additional ambulance records relating to all patients attended by paramedics after emergency 999 calls for which a "blue call" was issued to alert the receiving hospital of the imminent arrival of a patient assessed by the paramedics as needing very urgent attention. All children and all patients with single system head injuries attended during the daytime who met the other inclusion criteria were identified, and these patients have been included in the study.

INFORMATION RECORDED

Mortality

All patients were followed up for six months to assess survival. Patients who died at the scene or in hospital were identified from prehospital and hospital records. Patients who were discharged to other hospitals were followed up at the hospital from which they were last discharged. All patients not identified as having died or whose survival was not confirmed later (for example, by a response to an interview request) who were resident in the United Kingdom were followed up by using the NHS Central Registry at Southport. Patients from overseas discharged alive were assumed to be alive at six months (n=16). Deaths at the scene were subdivided by whether the history (in helicopter and ambulance records and coroners' reports) indicated that, although resuscitation was attempted, the patient never showed any signs of life and thus was possibly dead before the first responder arrived.

Severity of injury

Descriptions of injuries were taken from hospital notes and coded by using the abbreviated injury scale (1990) dictionary.[3] The scale assigns a severity score to each injury of between 1 and 6, higher scores denoting a greater threat to life. All hospital notes were reviewed

Criteria for inclusion in review of London helicopter emergency medical service

Operational

- Helicopter case: patient attended by helicopter crew from primary missions resulting in helicopter transfer, ground escort, or ground assist

Land case: patient attended by land ambulance crewed by paramedics and helicopter was not in attendance

- Patient taken to any one of 20 study hospital casualty departments between 8 am and 9 pm or died on scene but would have been taken to a study hospital if attended by ambulance

Clinical

- Externally caused (trauma) incident including drownings but excluding medical complications after surgery and falls within the home of less than 1 metre
- Any such patient attended by air or ground ambulance on whom resuscitation was attempted; and for land ambulance cases on whom paramedic skills were used; and who died at the scene or at hospital (during first admission episode) or who stayed in hospital for 72 hours or more or who had an initial triage revised trauma score ≤ 10 or who had an initial Glasgow coma score ≤ 12 with a head injury or who had an injury severity score >10

and scores coded by the same researcher (HS) for all the patients in both cohorts. For patients with multiple injuries, scores on the injury scale were combined to produce an injury severity score.[4 5] The severity score is the sum of the squares of the most severe injury scale scores occurring in three different body regions.

Glasgow coma score, respiratory rate, and systolic blood pressure assessed before arrival at hospital were obtained from both sets of records. The coma score measures neurological function, the score ranging from 3 to 15 with lower scores indicating poorer neurological functioning. Up to three recordings were taken to cover the time spent at the scene and in transit. These measures were also taken from accident and emergency notes if recorded there. Revised trauma scores, which are made up of the weighted sum of coded values of these three components, and triage revised trauma scores,[6] the unweighted sum more appropriate for use in the prehospital setting, were calculated. The revised trauma score ranges from 0 to 7·84 and the triage revised trauma score from 0 to 12. In both cases a higher score indicates less severe physiological derangement of the injured person at the time of measurement.

Trauma and injury severity score (TRISS)

One conventional method of evaluating survival after major trauma is the trauma and injury severity score (TRISS).[7] TRISS combines age, revised trauma score recorded on arrival at hospital, and injury severity score, separately for patients with blunt or penetrating injuries to yield a probability of death. TRISS norms or standards, as well as their component revised trauma scores, have been developed only for patients admitted to hospital. TRISS uses the earliest recorded revised trauma score on arrival in hospital. It also requires that the injury severity score is computed by using information in inpatient notes for survivors but inpatient notes and postmortem reports for deaths. This means that the severity score depends on outcome and may be higher, on average, if the patient dies.[8] Despite these difficulties, we computed scores for the two cohorts in a conventional way using the earliest recorded revised trauma score (usually on scene), severity score based on inpatient notes and postmortem reports, age groups 0-54 and ≥55, and weights derived from the United Kingdom major trauma outcomes study for blunt injuries[9] and the United States major trauma outcomes study for penetrating injuries (United Kingdom weights were not available).

We also directly compared survival adjusting for the minimum triage revised trauma scores recorded on the scene, severity score computed using inpatient notes only for both deaths and survivors, and age groups 0-64 and ≥65, which show the greatest association with survival (see table IV and Jones *et al*[10]).

Reweighting the stratified sample

The random sample of helicopter patients flown to the Royal London included in the study was weighted by a factor of three relative to other helicopter cases in all the analyses of outcomes so that the results reported here reflect the outcomes for all helicopter patients taken to any of the 20 study hospitals. This reweighting by the inverse of the sampling fractions is the conventional approach for obtaining unbiased population estimates from stratified samples.

Analysis of mortality

For adjusting comparisons of mortality for the three main known prognostic factors—injury severity score, revised trauma score or triage revised trauma score, and age—we either calculated TRISS or carried out a grouped data cohort analysis of relative risk. For the TRISS analyses the actual injury severity score and initial revised trauma scores of each patient were used and cases with missing values therefore had to be excluded. For the grouped data analyses, age (0-64, and ≥65), injury severity score (0-15, 16-24, and 25-74), and triage revised trauma score (0-9, 10-11, 12, and not recorded) were categorised, enabling the cases with missing data to be included.

When additional possible prognostic and confounding factors such as Glasgow coma scale, sex, and the types of incident were also considered, the number of confounding factors was so large as to make it necessary to analyse the data on a case by case basis. In these analyses the same methods were used, though the significance of the estimated effects of the helicopter adjusted for the confounding factors was assessed by using permutation tests.[11] For these analyses we used the log of the injury severity score rather than the categorical score. Using the relative risks of death estimated from this model, we calculated the expected number of deaths among all patients with major trauma attended by the helicopter if the patients had been attended by land ambulance.

Results

MISSING DATA

Injury severity scores were unrecorded in 21 patients whose notes could not be found and in 14 trauma patients who did not have injuries which could be scored on the abbreviated injury scale (for example, drownings, poisonings, hangings). There were also seven patients with an unsurvivable injury and six patients with no age recorded.

There were 158 (33·9%) ambulance patients and 29 (8·6%) helicopter patients who did not have all three components of the revised trauma score recorded either at the scene or in hospital. Compared with paramedics in the land ambulances the helicopter registrars rarely omitted any component of the trauma score, probably because they were more aware of the usefulness of these measurements. The disparity in the proportions of patients with missing triage revised trauma scores could have led to biases if these patients were excluded from the analyses. One alternative approach is to treat these scores as a categorical variable with "missing or not recorded" scored as a separate category. As there was no evidence that age, injury severity scores, and outcome differed between the helicopter and ambulance cohorts with missing data[2] this approach has been preferred in the analyses. To examine the robustness of the approach, however, some analyses were also carried out by excluding patients with missing scores.

PATIENTS INCLUDED IN THE OUTCOMES STUDY

During the 21 months in which patients attended by helicopter were assessed for inclusion in the outcomes study a total of 1145 such patients were recorded (table I), of whom 337 met the inclusion criteria. The other patients were either not taken to a study hospital

TABLE I—*Patients attended by helicopter emergency medical service who were assessed for inclusion in follow up*

Outcome of mission for patients attended	Recorded in study	Included in full assessment of outcomes
Died at scene	129*	32*
Helicopter transfers (flown to hospital)	374	128
Ground escorts (escorted to hospital accompanied by helicopter staff)	209	94
Ground assists (transferred to hospital unaccompanied)	433	83
All	1145	337

*Patients in whom no resuscitation was attempted were not assessed for inclusion in follow up study.

(n=304), were flown to the Royal London but were not sampled (n=189), or did not meet the clinical inclusion criteria (n=315).

During the same period, there were 466 patients attended by ambulance paramedics who met the inclusion criteria.

The types of incident in which patients were injured were broadly similar in the two cohorts, and the age and sex distributions were nearly identical (table II).

TABLE II—*Characteristics of cohorts attended by helicopter service or ground ambulance crew*

Characteristics	No (%) attended by helicopter (n=337)	No (%) attended by ground ambulance crew (n=466)
Type of incident:		
Road traffic accident	159 (47·5)	253 (54·3)
Falls	62 (18·5)	64 (13·7)
Other	116 (34·0)	149 (32·0)
Male patients	242 (71·8)	334 (71·7)
Age (years)*		
0-64	277 (82·6)	380 (82·2)
≥65	58 (17·4)	82 (17·8)
Major trauma (15<ISS†<75)	140 (42·7)	131 (28·4)
Severe injury (T-RTS‡≤9)	83 (26·9)	51 (16·6)
Severe head injury (GCS§≤9)	103 (32·5)	65 (18·6)

*Not known for two patients attended by helicopter and four attended by ambulance.
†Injury severity score; not known for 11 patients attended by helicopter and 10 attended by ambulance.
‡Triage revised trauma score; not known for 29 patients attended by helicopter and 158 attended by ambulance.
§Glasgow coma scale; not known for 21 patients attended by helicopter and 117 patients attended by ambulance.

TABLE III—*Number of deaths according to type of attendance*

Timing of death	No (%) attended by helicopter (n=337)	No (%) attended by ground ambulance crew (n=466)
Before hospital:		
Possibly dead on arrival*	17 (5·0)	15 (3·2)
Not dead on arrival	15 (4·5)	15 (3·2)
After arrival in hospital	60 (17·8)	47 (10·1)
Survivors	245 (72·7)	389 (83·5)

*Possibly dead on arrival of the helicopter or ambulance crew at scene of incident.

TABLE IV—*Survival by age and measures of injury severity*

Measure	Attendance by helicopter		Attendance by ground ambulance		Relative risk of death for helicopter *v* ambulance attendance (95% confidence interval)
	No (%) of deaths	No of survivors	No (%) of deaths	No of survivors	
Age (years):					
0-14	11 (19·6)	45	5 (8·3)	55	2·7 (1·0 to 10·8)
15-29	17 (18·7)	74	11 (9·0)	111	1·9 (0·9 to 4·6)
30-49	25 (26·3)	79	23 (17·0)	112	1·5 (0·9 to 2·8)
50-64	8 (22·9)	27	8 (12·7)	55	1·9 (0·6 to 5·5)
65-74	13 (52·0)	12	17 (40·5)	25	1·4 (0·8 to 2·5)
≥75+	16 (48·5)	17	13 (32·5)	27	1·8 (1·0 to 3·1)
Not recorded	0	2	0	4	
Injury severity score:					
0-8	4 (5·3)	72	3 (2·2)	133	2·0 (0·3 to 34·9)
9-15	8 (7·7)	96	10 (5·5)	171	1·7 (0·6 to 4·7)
16-24	8 (17·0)	39	9 (15·5)	49	0·8 (0·3 to 2·3)
25-40	47 (63·5)	27	40 (64·5)	22	0·9 (0·7 to 1·2)
41-66	14 (87·5)	2	5 (71·4)	2	1·3 (1·0 to 3·0)
75	4 (100·0)	0	3 (100·0)	0	1·0
Not scored	7 (43·8)	9	7 (36·8)	12	1·2 (0·5 to 2·8)
Triage revised trauma score:					
0	30 (93·8)	2	30 (96·8)	1	0·9 (0·8 to 1·1)
1-3	2 (66·7)	1	1 (100·0)	0	0·8
4-6	10 (58·8)	7	0	0	
7-9	12 (38·7)	19	9 (47·4)	10	0·7 (0·3 to 1·5)
10-11	15 (27·2)	40	10 (14·9)	57	2·2 (1·0 to 4·9)
12	16 (9·4)	154	4 (2·2)	186	4·0 (1·5 to 21·1)
Not scored	7 (24·1)	22	23 (14·6)	135	1·9 (0·7 to 4·2)
Glasgow coma score:					
3	42 (79·2)	11	45 (86·5)	7	0·7 (0·6 to 1·1)
4-6	11 (47·8)	12	10 (40·0)	15	1·0 (0·5 to 2·1)
7-9	6 (20·7)	23	4 (21·0)	15	1·1 (0·3 to 4·4)
10-12	7 (29·2)	17	4 (11·8)	30	2·9 (0·8 to 13·6)
13-14	4 (19·0)	17	4 (8·3)	44	2·1 (0·3 to 13·7)
15	16 (9·2)	157	5 (2·1)	238	4·8 (1·8 to 21·5)
Not scored	6 (42·9)	8	5 (11·1)	40	4·9 (1·7 to 22·5)

*Estimated after weighting helicopter sample flown to Royal London Hospital.

The patients in the helicopter cohort, however, were more severely injured with greater proportions having both major trauma and severe head injury.

SURVIVAL

There were 92 deaths in the helicopter cohort and 77 in the ambulance cohort (table III). We estimated from the recorded histories that although resuscitation was attempted, 17 of these helicopter deaths and 15 ambulance deaths may have occurred before the crews arrived at the scene. Whether these patients are included or excluded there were proportionally more deaths in the helicopter cohort both before and after arrival at hospital. In both cohorts the death rate increased with age (table IV), but this was mostly due to a difference in death rate between casualties aged 0-64 and those aged ≥65.

For patients sustaining major trauma (injury severity score ≥16) there was little difference between the outcomes in both groups of patients in terms of survival (table IV). For patients with minor injuries, however, there was some suggestion of poorer outcomes in the helicopter group, though the numbers of deaths in both groups were small. Investigation of those patients with low injury severity scores (≤8) who died found that these deaths were mainly from causes which could not be scored (for example, smoke inhalation with minor burns, cardiac myopathy with minor lacerations) or occurred in old people after admission to hospital with minor injuries. Patients with evidence of severe head injuries (Glasgow coma scale ≤9) had similar death rates in the two cohorts (table IV).

MULTIVARIATE COMPARISONS

Just over two thirds (300/466) of the ambulance cohort and nearly 90% (293/337) of the helicopter cohort had complete data enabling TRISS to be calculated. For all deaths, and with the helicopter sample weighted to reflect the one in three sampling of helicopter cases flown to the Royal London, the actual number of helicopter deaths exceeded the number predicted from the norms from the major trauma outcomes study by 15·6% compared with an excess of 2·4% in the ambulance cohort. When deaths which may have occurred before the emergency medical crews arrived at the scene were excluded, there were 17·2% more deaths in the helicopter cohort than predicted by TRISS compared with 0·5% in the ambulance cohort.

Analyses of relative risk

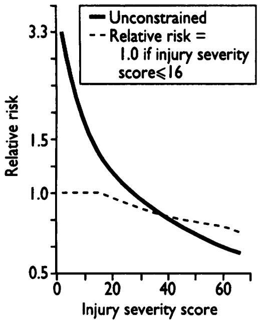
Grouped comparisons—There was no evidence that the risk of death in patients attended by helicopter relative to the risk in patients attended by ambulance ground crews varied between all combinations of age, triage revised trauma score, and injury severity score (G^2=43·6; df=36; P>0·3). Assuming, therefore, that the relative risk is constant, there was no evidence at all of any difference in death rates between the helicopter and the ambulance (G^2=0·01; df=1; P>0·5). The same result was found whether the cases with missing triage revised trauma scores were included or excluded. When patients possibly dead on arrival of the emergency medical crews were excluded the estimated relative risk associated with helicopter attendance increased, but in all cases the estimated relative risk was not significant and was within 9% (table V).

Individual case analyses—When survival was assessed on a case by case basis after adjustment for injury severity score, triage revised trauma score, and age there was no evidence that mortality was related to Glasgow coma scores, score for head injury on the abbreviated injury scale, sex, or the type of incident.

TABLE V—*Estimates of risk of death in patients attended by helicopter relative to risk in patients attended by ambulance ground crews*

Deaths	Patients with missing triage revised trauma score	Relative risk* (80% confidence interval; 95% confidence interval)
All deaths	Included	0·99 (0·77 to 1·24; 0·69 to 1·40)
	Excluded	0·95 (0·74 to 1·21; 0·65 to 1·38)
Deaths excluding those dead on arrival†	Included	1·09 (0·84 to 1·40; 0·74 to 1·61)
	Excluded	1·05 (0·80 to 1·38; 0·69 to 1·60)

*Weighted to take account of one in three sample of cases flown by helicopter to Royal London Hospital.
†Deaths that may have occurred before arrival of emergency medical crew.



Risk of death in patients with trauma attended by helicopter v *ground ambulance*

After adjustment for age and triage revised trauma score there was some weak evidence that as the log injury severity score increased, helicopter patients did increasingly well relative to the ambulance patients (G^2=2·8) (figure). All the earlier analyses and the model described above suggest that patients with low injury severity scores in the helicopter cohort may have had an increased risk of death relative to comparable patients in the ambulance cohort. We assumed that this was an artificial effect as has been claimed[12] and recalculated the relations between injury severity score and survival for helicopter and ambulance patients, adjusted for age and relative trauma score, with the relations constrained to be the same for injury severity scores 1-15. There was no reliable evidence of a difference between the helicopter and ambulance cohorts in the relation between injury severity score and outcome (G^2=0·58), although this model also predicted that the risk of death in the helicopter cohort relative to the ambulance cohort fell with increasing severity of injury (figure). If we assume that the relative risk in helicopter patients at an injury severity score of 16 is 1·0, the estimated relative risk at an injury severity score of 41 is 0·82 (95% confidence interval 0·49 to 1·39). Based on the estimated number of patients with major trauma with injury severity scores of 16 or over in the whole helicopter caseload during the 21 months, this model predicts that the number of additional survivors in patients with major trauma (injury severity score ≥16) attended by the helicopter is 13 a year (bootstrapped 95% confidence interval −5 to 39; 80% confidence interval 0 to 29).

Discussion

The helicopter emergency medical service could improve patient care by reducing the time of transfer to hospital, improving the skills available at the scene, or increasing the choice of hospital to which the patients can be transferred. Compared with land ambulance patients, the helicopter patients received medical attention (on the scene from doctors) 25 minutes earlier on average but arrived in hospital 10-20 minutes later.[2] They were more intensively managed at the scene and spent an average of 6 minutes longer there. Severely injured patients were often managed by helicopter doctors in ways which are not available to paramedics in London. For example, patients were often intubated after being anaesthetised; patients with head injury were routinely given intravenous mannitol; and invasive procedures were occasionally carried out, although patients rarely survived when these skills were needed. In addition, the helicopter service triaged patients to hospitals with appropriate and adequate facilities on site which may have been needed in the care of the patients. In comparison with ambulance patients, helicopter patients were rarely transferred within six hours of arrival at the primary receiving hospital for possible emergency care. These differences in the process of prehospital care suggest that the helicopter service could be affecting outcomes.

After taking into account the differences that there were in terms of age and the nature and severity of injuries, however, we estimated that for all patients the survival rates in the two cohorts were the same. There was some suggestion that helicopter patients with minor injuries did worse than ambulance patients but that those with major trauma were more likely to survive than ambulance patients. The apparently worse outcomes for helicopter patients with comparatively minor trauma may be due to the play of chance or to unmeasured differences between the patients in the two cohorts,[12] and may not reflect an effect of the service. If we assume that this is the case only for minor trauma patients then the statistical evidence for any benefit for major trauma patients is weak, but it may indicate a small possible survival advantage in severe trauma.

An individual review of all helicopter patients in the follow up sample who survived with very severe injuries (injury severity score ≥25) found one patient with a non-patent airway who had a cricothyroidotomy who it was thought would certainly not have survived if attended by a non-medical crew. There were other patients who may have survived because of the interventions of the helicopter team, but there were similar ambulance patients in the study who also survived, and the benefit in these cases is therefore uncertain. On the other side of the equation the review also found two patients with no vital signs who survived who were attended by the helicopter, but in both cases an ambulance ground crew was first at the scene and managed to resuscitate the patients. These patients may not have survived if attended only by a helicopter ambulance. The comparatively longer time spent at the scene of the incident for helicopter patients may also be leading to poorer outcomes in some groups of patients.

We were not able to review in detail all the patients attended by the helicopter with major trauma who survived during the 21 months of the full study as only those taken to one of 20 study hospitals and only one third of those flown to the Royal London were included in the follow up. We have, however, followed up over 40% of all the major trauma patients attended by the helicopter in 21 months. Thus the review suggests that there may be a few very seriously injured patients each year who survive as a result of the helicopter attending the scene. This is an agreement with the results of the statistical model contrasting the relation between injury severity scores and outcome in major trauma patients in the helicopter and ambulance cohorts.

It should be emphasised that the difference in the relation between severity of injury and outcome in both groups of patients with major trauma was not significant, and the relative risk in helicopter patients may not fall with increasing severity of injury. Furthermore, it has also been reported in a large multicentre study from America that patients with comparatively minor injuries did worse with prehospital care provided by helicopter than with conventional ground

Key messages

- The London helicopter emergency medical service is a large medically crewed helicopter operating from the Royal London Hospital during daylight hours, targeted at patients with serious injuries
- Patients are typically young men seriously injured in road traffic accidents
- Patients are more intensively managed than comparable land ambulance patients, but they spend longer at the scene and arrive in hospital later
- Patients with very serious injuries attended by the helicopter may be more likely to survive than comparable patients attended by paramedically crewed land ambulances but other patients may be less likely to survive
- For the whole helicopter caseload survival rates are the same as for comparable patients attended by paramedically crewed land ambulances

transport, while patients with severe injuries did better with helicopter services.[13] The striking similarity to our results does suggest that there is uncertainty about the overall benefits of helicopters in terms of survival, and in contrast with the American results we found no evidence at all that the London helicopter emergency medical service was improving chances of survival for the whole group of patients with trauma that it attends.

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Incidence of and mortality from acute upper gastrointestinal haemorrhage in the United Kingdom

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Abstract

***Objective*—To describe the current epidemiology of acute upper gastrointestinal haemorrhage.**

***Design*—Population based, unselected, multicentre, prospective survey.**

***Setting*—74 hospitals receiving emergency admissions in four health regions in the United Kingdom.**

***Subjects*—4185 cases of acute upper gastrointestinal haemorrhage in which patients were aged over 16 years identified over four months.**

***Outcome measures*—Incidence and mortality.**

***Results*—The overall incidence of acute upper gastrointestinal haemorrhage in the United Kingdom is 103/100 000 adults per year. The incidence rises from 23 in those aged under 30 to 485 in those aged over 75. At all ages incidence in men was more than double that in women except in elderly patients. 14% of the haemorrhages occurred in inpatients already in hospital for some other reason. In 27% of cases (37% female, 19% male) patients were aged over 80. Overall mortality was 14% (11% in emergency admissions and 33% in haemorrhage in inpatients). In the emergency admissions, 65% of deaths in those aged under 80 were associated with malignancy or organ failure at presentation. Mortality for patients under 60 in the absence of malignancy or organ failure at presentation was 0·8%.**

***Conclusions*—The incidence of acute upper gastrointestinal haemorrhage is twice that previously reported in England and similar to that reported in Scotland. The incidence increases appreciably with age. Although the proportion of elderly patients continues to rise and mortality increases steeply with age, age standardised mortality is lower than in earlier studies. Deaths occurred almost exclusively in very old patients or those with severe comorbidity.**

Introduction

Acute upper gastrointestinal haemorrhage remains a common reason for admission to hospital, and in north east Scotland in 1967-8 it was responsible for 8% of all emergency admissions to adult medical wards.[1] A large district general hospital with a catchment population of 300 000 might expect to admit one such case each working day of the year. It is also not uncommon in patients already in hospital, contributing significantly to overall mortality.[1]

Current knowledge of the epidemiology of acute upper gastrointestinal haemorrhage in the United Kingdom and worldwide mostly comes from hospital based studies of under 1000 cases,[1,2] larger retrospective studies,[3] studies without any defined population base,[4] and indirect methods of calculation and estimation.[5] No population based studies have been undertaken for 25 years, during which time endoscopy for acute upper gastrointestinal bleeding has become routine. In the population based studies that have been undertaken in the United Kingdom incidence has varied from 47 per 100 000 in Oxford[3] to 116 in north east Scotland,[1] and mortality has been reported as about 10%. We report the results of a large, prospective, population based study and discuss the current epidemiology of the condition, the relation between patient characteristics and outcome, and the prospects for reducing mortality.

Subjects and methods

The data presented were collected over four months as part of a national audit of the management and