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Original Research

Prehospital Death After Traumatic Cardiac Arrest: Time for Better Feedback?

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A B S T R A C T

Objective: The aim of this study was to establish if in patients who die at scene as a result of traumatic cardiac arrest (TCA), their cause of death could be determined through coroners reports, and to ascertain the quality of the feedback provided.
Methods: This is a retrospective study of all patients presenting in TCA who were attended by the Air Ambulance Kent, Surrey and Sussex between January 1, 2015, and June 30, 2016.
Results: In total, 159 patients were attended to during the study period. Postmortem reports could not be obtained for 37 patients, mainly because of unestablished identities at the scene. Forty of the 122 reports obtained were full postmortem reports, 3 were inquest reports, and for 79 patients only their (presumed) cause of death was provided. A specific cause of death was provided for 68 patients, whereas in the remaining 54 patients the cause of death was given as "multiple injuries." In 32% of the patients with a full postmortem report, injuries were identified during the postmortem examination that had not been noted on scene.
Conclusion: Feedback from coroners to prehospital teams after patients die as a result of TCA is important but currently suboptimal.

Major trauma is a leading cause of mortality and serious morbidity, particularly in the young.[1-3] Prehospital care teams are faced with the challenge of promptly recognizing injuries in patients on scene in order to improve their outcome. Being able to diagnose the injuries in trauma patients in the prehospital setting correctly requires training and experience because patients are usually examined under suboptimal conditions with a limited set of diagnostic tools.

It is important that prehospital clinicians receive feedback on their findings and treatments in order to be able to improve the care they provide to future patients.[4,5] Clinical follow-up is usually obtained via the receiving hospital. However, when patients die on scene, this opportunity does not exist, and feedback has to be sought from the coroner's reports. In the United Kingdom, all sudden, unexplained, and violent or "unnatural" deaths are referred for investigation to Her Majesty's Coroner for the jurisdiction within which the death occurred.

The aim of this study was to establish how frequently the cause of death of patients in traumatic cardiac arrest (TCA) attended by a helicopter emergency medical service (HEMS) could be established through coroners' reports and to ascertain if the feedback provided to the clinical teams has the potential to improve clinical care for future patients.

Methods

Study Setting and Design

This is a retrospective study of patients in TCA attended by the Air ambulance Kent, Surrey and Sussex (AAKSS) between January 1, 2015, and June 30, 2016. AAKSS is an HEMS covering 3 counties in the UK with a resident population of 4.5 million and a transient population of up to 8 million. Two doctor/paramedic teams respond 24/7 in either a helicopter or response car, attending to approximately 2000 patients per year.

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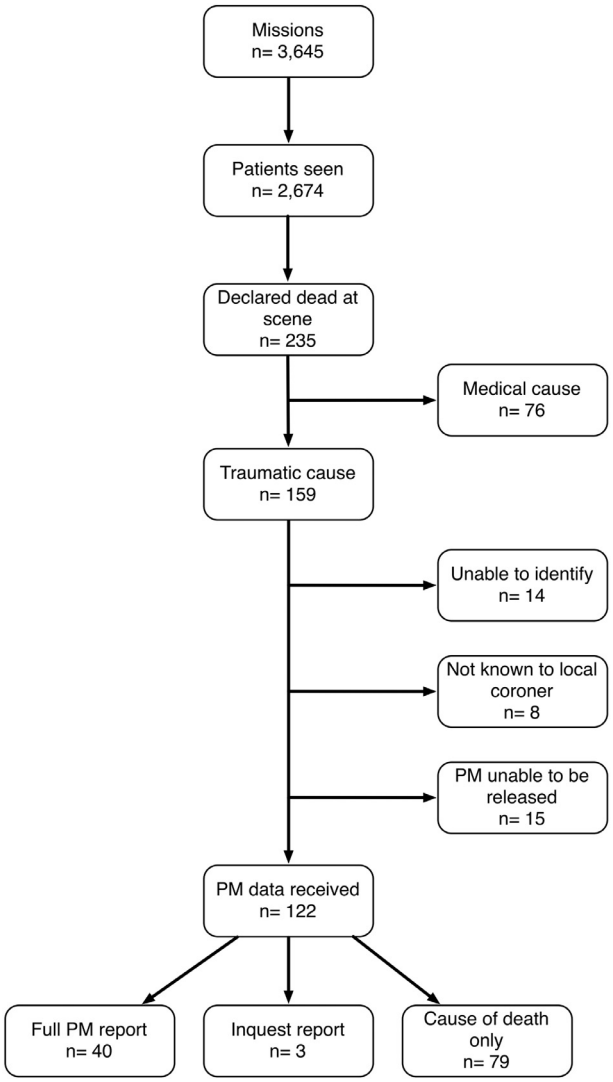

Figure 1. A Flowchart of Patient Inclusion

Study Population

Patients were eligible for participation in the study if they had TCA, were attended by HEMS, and died at the scene of the incident. TCA was defined as any cardiac arrest after a trauma. This included patients with blunt or sharp injuries, burns, hangings, traumatic asphyxia, electrocution, or drowning. We excluded patients who were pronounced life extinct after a medical event and patients who had TCA but were transported to the hospital with or without return of spontaneous circulation.

Classification of out-of-hospital arrests as either medical or traumatic was acknowledged by the treating physician at the time of the treatment and documented as a mandatory binary entry in the bespoke electronic patient clinical record system AAKSS uses (HEMSbase; Medic One Systems Ltd, Surrey, UK). Classifications were reviewed by 1 of the investigators (E.M.) and compared against the clinical information available in HEMSbase. In case of disagreement with the classification as given by the treating physician, the case was discussed with a second reviewer in order to establish final classification.

Data Acquisition

The HEMSbase electronic patient clinical record system was searched in October 2016 for all patients pronounced life extinct after a traumatic injury by the HEMS team in the period between January 1, 2015, to June 30, 2016. For these patients, mechanism of injury, injuries identified on scene, treatments on scene (both by ambulance crews and HEMS team), and perceived cause of death were retrieved. The available postmortem reports from the 7 coroners' offices in the AAKSS area were reviewed and compared with AAKSS clinical notes in order to establish which injuries were present, correctly identified, or missed. All data were anonymized and stored electronically in a secure database.

The outcomes of interest were the percentage of patients with TCA who were pronounced life extinct at the scene for whom the cause of death could be established through a coroner's report and the agreement between clinical diagnosis and coroners reports for patients who die after TCA.

Ethical Considerations

This project met the National Institute for Healthcare Research criteria for service evaluation; therefore, formal ethical approval was not requested. The project was approved by the AAKSS Research and Development Committee and registered as a service evaluation with the University of Surrey.

Statistical Analysis

Descriptive statistics are given as means (95% confidence interval) or medians (interquartile range). All statistical analyses were conducted using SPSS 23.0 for Windows (IBM Corp, Armonk, NY).

Results

Patients

During the study period, AAKSS responded to 3,645 missions and attended to 2,674 patients. In total, 235 patients were pronounced life extinct at the incident scene. Of these, 76 were excluded with medical etiology. Our study population consisted of the remaining 159 patients. The median age was 64 years (range, 14–93 years). The vast majority were male (76%) and were involved in a road traffic collision (62%). Other mechanisms of injury were intentional self-harm (10%), assault with penetrating injury (3%), fall from height (2%), sporting injuries (2%), burns (1%), and other incidents (20%).

Postmortem Availability

Fourteen patients who died at the scene could not be identified at the time and subsequently did not have a name entered into HEMSbase. Despite extensive investigation after the incident, it was not possible to determine with certainty the identity of these patients. Therefore, postmortem reports for these patients could not be obtained. Based on the information available to AAKSS, 8 further patients who died at the scene were not known to any of the regional coroners' offices, and, therefore, postmortem reports were unavailable. In 15 additional cases, coroners' offices were unable to share the postmortem report pending inquest or awaiting further results (such as toxicology or histology reports). In total, 40 full postmortem reports were received, 3 inquest reports were received, and in 79 stated cases coroners provided information on the primary cause of death only (Fig. 1).

Coroners' Reports

The cause of death according to the coroner's report was "multiple injuries" for 54 (44%) patients. A more specific cause of death was provided for 68 patients. The most prevalent cause of death was head injury (n = 15, 12%). A fair amount of variation was present in the degree of detail of the injuries reported. The cause of death is provided in Table 1. Not all causes of death were of traumatic origin. Among the nontraumatic causes listed were ischemic heart diseases (n = 8, 7%) and a heroin overdose (n = 1, 1%).

Table 1
Causes of Death According to Coroners' Reports (N = 122)

Cause of death	n (%)
Multiple injuries	54 (44)
Head injuries	15 (12)
Ischemic heart disease	8 (7)
Hanging	7 (6)
Asphyxia	6 (5)
Spinal cord injury	5 (4)
Ruptured/dissected aorta	3 (2)
Laceration thoracic aorta	2 (2)
Exanguination	3 (2)
Chest injuries, unspecified	3 (2)
Stab to heart	3 (2)
Stab to lung	2 (2)
Blunt chest trauma	3 (2)
Hemothorax	1 (1)
Pulmonary contusions	1 (1)
Inhalation of fumes	2 (2)
Drowning	1 (1)
Stab to arm	1 (1)
Electrocution	1 (1)
Heroin overdose	1 (1)

Correlation of Clinical Assessment With Postmortem Reports

In 13 (32%) of the patients for whom a full postmortem report was available, injuries were identified during the postmortem examination that had not been noted on scene. These included fractures of mandible, cervical vertebra C4 and C5, humerus, radius, ulna, pubic rami, and femur; multiple liver lacerations; unspecified renal injury; dissected aorta; spinal cord transection; and a flail chest.

Discussion

In this study, we show that coroners' reports are not always available to prehospital teams and that the amount of detail provided in the reports is variable. This can make it hard for prehospital teams to evaluate the quality of care provided systematically.

Coroners' reports are not available to prehospital teams when the identity of the patient cannot be established with certainty. This is frequently the case in patients involved in road traffic collisions (RTC's) because these tend to occur in public places rather than at home. Confirming the identity of a patient may require follow-up investigation or conversation with the police involved at the scene and is more likely to be successful if undertaken directly on scene or soon after the incident. When this is not achieved by the medical crew, it is impossible to retrieve postmortem reports for these patients at a later stage.

In our study, a full postmortem was performed in only a minority (40/122, 33%) of the patients. This is consistent with a general decline in the number of postmortem being performed,[6,7] even though postmortem computed tomographic scanning is on the rise.[8,9] In the remaining patients, coroners reported the cause of death only, and no details were provided about the injuries sustained by the patient. Although knowing the cause of death might be of some value to the clinical team, the potential for evaluation of clinical care provided increases when more specific injuries are reported.

Receiving feedback is very important for prehospital teams. In 32% of the patients with a full postmortem report (13/40) in this study, injuries were identified during the postportem evaluation that were not discovered on scene. This is consistent with findings in a previous study of prehospital trauma patients[10] although (as expected) higher than for in-hospital trauma patients for whom more radiologic modalities are available.[11] Although some of these missed injuries may be classified as minor injuries not contributing to the cause of death, some may have been the actual cause of death or at least have contributed to it. Furthermore, postmortem reports challenged the TCA diagnosis. A proportion of the patients whom the medical team thought had TCA probably had a medical arrest with resultant trauma. According to the coroners' reports, 8 patients died of ischemic heart disease and 1 of a heroin overdose. Knowing the exact cause of death is important because it may help improve pattern recognition of the HEMS crews and thereby expedite and improve care for future patients. Furthermore, it enables HEMS crews to reflect on the interventions provided because postmortem reports have the potential to demonstrate if these were performed for the right indications and up to standards.

Despite the value of postmortem reports, automatic sharing of postmortem findings with prehospital emergency medical services is not (yet) routine in the UK and in many other countries. A specific request to the coroner's office is needed to obtain postmortem data, which may be a barrier for prehospital services (and individual crews) to obtain.

We acknowledge several limitations in our study. First, the number of TCAs included in our study was relatively small. Therefore, our findings should merely be regarded as proof of concept. Furthermore, as with all retrospective studies, robustness of the conclusions relies on accurate data recording. Because TCAs usually occur in subjects with multiple injuries requiring treatments that take up a significant amount of bandwidth of the crews present, it is unclear whether discrepancies between postmortem findings and clinical findings were the result of missed diagnoses, incomplete notes, or a combination of both. Finally, we only looked at patients with TCA, and our findings cannot be extrapolated to other patients who are pronounced life extinct prehospitally.

Conclusion

Feedback from coroners to prehospital teams after patients die as a result of TCA is important but currently suboptimal. It is the responsibility of the prehospital team to establish patients' identity early and to seek feedback from coroners' reports, which should be specific enough to have the potential to improve care for future patients.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.1016/j.amj.2018.11.010.

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