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Brief Report

Hemorrhage Treatment Adjuncts in a Helicopter Emergency Medical Service

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ABSTRACT

Hemorrhaging is the leading cause of preventable death after trauma. In our helicopter emergency medical service (HEMS), we introduced a bundle of 3 hemostatic adjuncts: 1) tourniquet, 2) hemostatic chitosan-based wound packings, and 3) tranexamic acid (TXA). The real-life frequency of applying these adjuncts in HEMS remains unclear. Therefore, we analyzed our electronic HEMS database regarding the use of these hemostatic adjuncts. We analyzed all subsequent dispatches of our HEMS "Lifeliner 1" within a searchable digital database (01.02.2013-22.05.2018). This HEMS operates 24/7, servicing ~4.5 million inhabitants of the Netherlands. During the 75-month study period, we registered 15,759 dispatches, of which 8,658 were canceled, and 7,101 included on-site patient care, including 4,928 (69.4%) trauma cases. In total, we recorded 78 tourniquet applications (1.1% of patients), 104 hemostatic wound packings (1.5% of patients), and 1,379 cases with prehospital TXA administration (19.4% of patients). This difference in the use of hemostatics has several contributors, including a possible lack of awareness for tourniquets and procoagulant wound packing, a high proportion of blunt trauma with internal bleeding not accessible to tourniquet or wound packing, and a liberal use of TXA (eg, in patients with unproven hemorrhage). Besides creating awareness for those hemostatic adjuncts, the practical implications of our findings need further evaluation in future studies.

Hemorrhaging is the leading cause of preventable death after trauma, both in military and civilian settings.[1] In the military setting, aggressive use of antihemorrhage adjuncts is emphasized by international guidelines for Tactical Combat Casualty Care,[2] translated into international civilian guidelines for Tactical Emergency Casualty Care.[3] In accordance, in our civil helicopter emergency medical service (HEMS), we introduced a bundle of 3 Tactical Combat Casualty Care/Tactical Emergency Casualty Care–approved hemostatic adjuncts 7 years ago:

1. Tourniquet: for extremity hemorrhages, we introduced a disposable tourniquet (C.A.T. tourniquet; North American Rescue, Sterling, VA).[4]
2. Hemostatic wound packing: for torso and junctional hemorrhage, we introduced third-generation chitosan-based hemostatic wound dressings (Celox gauze; MedTrade, Crewe, UK) and wound-injectable granules (Celox-A applicator, MedTrade).[5,6]
3. Antifibrinolytics: as a systemic pharmacological adjunct, we added tranexamic acid (TXA) to our intravenous medications (standard adult dose = 1,000 mg, Cyclokapron; Pfizer, New York, NY).[7]

Data on the real-life frequency of the use of these 3 antihemorrhage adjuncts are lacking for civilian HEMS. Therefore, we analyzed our electronic databases regarding the use of these 3 antihemorrhage adjuncts in a large, civilian HEMS.

Methods

We analyzed all 15,759 subsequent dispatches of our HEMS "Lifeliner 1" in a searchable digital database (01.02.2013-22.05.2018). This HEMS operates 24/7, servicing ~4.5 million inhabitants of the Netherlands. It is selectively dispatched to critical cases, ensuring that virtually all patients with life-threatening hemorrhages are treated by this HEMS.

The potential cases were searched and cross-checked in 2 independent HEMS databases. The first source is a flight nurses–serviced database (Excel; Microsoft, Redmond, WA) containing summarized case information. The second source is an extensive Web-based

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database filled in by HEMS physicians and cross-checked by the HEMS flight nurse. After searching predefined intervention menu items in both databases, we also searched the free-text entries in both databases for the keywords "tourniquet," "celox," "chito*," "tranex*," "txa," and "cyclokapron."

This retrospective chart review does not fall under the Dutch Law on Medical Scientific Research Involving Human Beings Wet medisch-wetenschappelijk onderzoek met mensen (WMO); therefore, formal approval of the institutional review board was not required.

Results

During the 75-month study period, we registered 15,759 HEMS dispatches, of which 8,658 were canceled en route, and 7,101 included on-site care. The majority of patients were male (68.7%), and the median (interquartile range) age was 44 (23-63) years. Of those dispatches involving patient care, most were trauma cases (69.4%), of which the vast majority (86.5%) were blunt trauma. The main causes of trauma were traffic accidents (46.7%) and falls from height (32.7%).

In total, we recorded 78 cases of prehospital tourniquets (1.1% of patients), 104 cases of prehospital chitosan-based wound packing (1.5% of patients), and 1,379 cases of prehospital TXA administration (19.4% of patients). Tourniquets plus chitosan-based wound packing were used in 12 cases (0.2% of patients), tourniquets plus TXA in 58 cases (0.8% of patients), chitosan-based wound packing plus TXA administration in 72 cases (1.0% of patients), and all 3 adjuncts together in 8 cases (0.1% of patients).

Discussion

Our data show a frequent administration of TXA (19.4%) compared with a rather seldom application of tourniquets or hemostatic wound packings (1.1% and 1.5%, respectively). There may be several reasons for this difference; in general, awareness for the use of tourniquets and hemostatic wound packings may still be limited in civilian HEMS.[8-12] However, in our case, the introduction of our antihemorrhage bundle with tourniquets, chitosan-based wound packing, and TXA administration was promoted repeatedly, rendering the option of lacking awareness less likely in our HEMS.

The initial treatment mode of external bleeding in our population may contribute to the difference in the use of hemostatic adjuncts; generally, the first emergency medical service arriving on the scene initiates external hemorrhage control with conventional (pressure) bandages, which are frequently sufficient to stop external bleeding. Thereafter, the HEMS team will cross-check that the bleeding remains stopped but will not replace sufficiently effective (pressure) bandages. However, in those cases, the HEMS physician might still administer TXA,[7] contributing to the relatively high number of TXA administrations (19.4%) in our HEMS registry.

The spectrum of injuries encountered in our HEMS also contributes to the infrequent use of tourniquets and hemostatic wound packings.[9] For example, in contrast to combat settings, in which extremity hemorrhages from (partial) amputations are typical tourniquet indications, these injuries are rare in civilian HEMS.[9] Also, massive external bleeding accessible to wound packing (eg, torso and junctional areas) are relatively rare in our HEMS compared with combat scenarios with gunshot or blast injuries. In contrast, the vast majority of our HEMS trauma cases are blunt trauma (86.5%), usually without major external hemorrhages. However, these blunt trauma cases (eg, traffic injuries) are prone to internal bleedings with a frequent indication for TXA administration.

Furthermore, TXA is not only administered in the case of a proven hemorrhage but also if a hemorrhage is suspected. This liberal use of TXA is supported by TXA's beneficial safety profile.[7,13,14] Additionally, prehospital trauma patients are exposed to factors that derange the coagulation system (eg, hypothermia, tissue acidosis, or fluid load), rendering prehospital TXA administration for clot stabilization[15,16] a tempting concept in patients who are not (yet) bleeding significantly.

Few studies are published on real-life prehospital use of hemostatic adjuncts (ie, tourniquet, chitosan-based wound packings, and TXA) according to literature research (PubMed.org). Most of these studies are derived from combat settings,[17] further limiting the available data on civilian emergency medical services.[18,19] Regarding civilian HEMS, 2 tourniquet case reports,[12,20] no studies on chitosan-based wound packings, and 2 studies addressing TXA have been published.[21,22] To the best of our knowledge, we present the first study on the use of these 3 hemostatic adjuncts in civil HEMS.

Our observational data may be used to elicit further studies that could improve patient care (by initiating benchmarks with other HEMS, by relating future data to patient outcomes,[23] or by possibly extending our hemostatic bundle with prehospital fibrinogen administration).[24]

In conclusion, we analyzed about 7,000 HEMS cases, including about 5,000 trauma cases, and showed a difference in the use of the 3 hemostatic adjuncts (ie, tourniquet, chitosan-based wound packing, and TXA). This difference has several contributors, including a possible lack of awareness regarding tourniquets and hemostatic wound packing, a high proportion of blunt trauma with internal bleedings not accessible to tourniquet or wound packing, and a liberal use of TXA (eg, in patients with unproven hemorrhage). In addition to creating awareness for the prehospital application of various hemostatic adjuncts, other practical implications of our findings need further evaluation in future studies.

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