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Limited volume resuscitation in hypotensive elderly multiple trauma is safe and prevents early clinical dilutive coagulopathy – A matched pair analysis from TraumaRegister DGU®

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ABSTRACT

Background: The use of permissive hypotension includes a restrained volume preclinical therapy. However, in the elderly patients, this approach has raised concerns because of the increased cardiovascular risk profile and a higher incidence of hypertension under normal conditions. The aim of the study was to examine whether preclinical administration of restrictive volume therapy in the elderly patient can be safe.

Patients and methods: A retrospective matched-pair analysis with the data set of the TraumaRegister DGU® (TR-DGU) was performed based on data of 176 pairs of totally 67,000 patients. To address elderly potentially bleeding patients without major brain injury the following inclusion criteria were chosen: patients $\geq$ 60 years, ISS $\geq$ 16, AIS head $<$ 4, preclinical blood pressure between 60 and 100 mmHg and recorded preclinical volume administration. Patients that met the inclusion criteria (908) were divided into two groups: pre-clinical volume resuscitation $\leq$1000 ml (=low volume) and $>$1000 ml (high volume). Patients with high- and low-volume fluid replacement were matched according to the following criteria: age group, gender, date of the accident $\pm$5 years, ISS, GCS, preclinical intubation, ground-/air-transport, pre-clinical blood pressure.

Results: Preclinical volume resuscitation showed a difference of about 1000 ml between the "low volume" and "high volume" group. The "low volume" group showed a significantly elongated prothrombin time. The amount of blood products given in the emergency department was not significantly different. The ventilation was 2 days shorter in the "low volume", although the number of patients with severe thoracic trauma was greater in this group. The length of stay in the ICU differed by 3 days in favour of the "low volume" group. The overall mortality was almost the same in both groups.

Conclusions: Based on these data it can be assumed that the lower preclinical volume administration has a positive effect on the initial coagulation status in elderly patients. In spite of some limitations such as low number of matched pairs, we draw the cautious conclusion that a restrictive preclinical volume therapy is safe and also indicated in elderly patients.

Introduction

Bleeding and the sequels of a severe blunt brain injury remain the leading causes of death in trauma patients [1]. Surgical bleeding control is the most urgent strategy in the bleeding trauma patients and all efforts in preclinical and early in-hospital trauma care aim for a rapid bleeding source identification and surgical bleeding control. The prehospital and early clinical volume support can bridge a haemodynamically unstable patient until surgical bleeding control. However, crystalloid volume support causes a dilution of clotting factors in the circulation [2], while colloids have in addition to their diluting component a direct inhibitory effect on thrombocyte functions [3]. In addition, volume support especially in a prehospital setting may exaggerate patient's hypothermia,

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which in turn further compromises the coagulation system. This self-reinforcing problem of bleeding with consumption of clotting factors, hypothermia and acidosis as a sequel of shock-associated hypoperfusion has been named the "deathly triad of trauma" [4]. Under the light of these considerations a very liberal use of volume substitution in traumatic shock patients especially in the prehospital phase may cause deleterious side effects.

For penetrating trauma the concept of a minimised fluid volume support is nowadays generally recommended in order to avoid a further dilution of clotting factors [8]. It is still a matter of debate, whether the promising data from patients with penetrating torso trauma treated prehospitally with the concept of a permissive hypotension can be transferred to patients with blunt trauma without any limitation, since even large randomised trials were able to show a clear effect on mortality [5–7]. In addition, there exist several settings, where a more liberal use of volumes substitution may be of value also in prehospital settings. For instance, the presence of an accompanying brain injury necessitates a more aggressive preclinical volume support to assure an adequate cerebral perfusion. In these cases the blood pressure must be kept above 90 mmHg to prevent secondary brain injury.

Beside the very frequent brain injury the increasing age of the trauma patients arises especially in the Western world additional concerns for the generally restricted preclinical volume support in trauma patients. Hypertension is very common in elderly patients and it is an ongoing debate whether these patients tolerate a systolic blood pressure of e.g. 80 mmHg in a shock situation just like a young adult. Further, pre-existing arteriosclerosis, which is well known to be associated with arterial hypertension may also limit the tolerance to lower blood pressure in the elderly. On the other hand, especially the elderly trauma patients are more frequently under anticoagulant therapy. These medications render the old trauma patient even for sensitive to the detrimental effects of a dilutive coagulopathy.

In order to address this controversial topic we analyzed the effect of preclinical volume replacement in the older patient with evidence for shock in terms of outcome and effect on the coagulation systems. Since controlled trials are difficult to perform on these topics we addressed the question by means of a retrospective matched-pair analysis of the TraumaRegister DGU®.

Patients and methods

The TraumaRegister DGU®

The TraumaRegister DGU® of the German Trauma Society (Deutsche Gesellschaft für Unfallchirurgie, DGU) was founded in 1993. The aim of this multi-centre database is an anonymous and standardised documentation of severely injured patients.

Data are collected prospectively in four consecutive time phases from the site of the accident until discharge from hospital: (A) prehospital phase, (B) emergency room and initial surgery, (C) intensive care unit and (D) discharge. The documentation includes detailed information on demographics, injury pattern, comorbidities, pre- and in-hospital management, course on intensive care unit, relevant laboratory findings including data on transfusion and outcome of each individual. The inclusion criterion is admission to hospital via emergency room with subsequent ICU/ICM care or reach the hospital with vital signs and die before admission to ICU.

The infrastructure for documentation, data management, and data analysis is provided by AUC – Academy for Trauma Surgery (AUC – Akademie der Unfallchirurgie GmbH), a company affiliated to the German Trauma Society. The scientific leadership is provided by the Committee on Emergency Medicine, Intensive Care and Trauma Management (Sektion NIS) of the German Trauma Society. The participating hospitals submit their data anonymously into a central database via a web-based application. Scientific data analysis is approved according to a peer review procedure established by Sektion NIS.

The participating hospitals are primarily located in Germany (90%), but a rising number of hospitals of other countries contribute data as well (at the moment from Austria, Belgium, China, Finland, Luxembourg, Slovenia, Switzerland, The Netherlands, and the United Arab Emirates). Currently, approx. 25,000 cases from more than 600 hospitals are entered into the database per year. Participation in TraumaRegister DGU® is voluntary. For hospitals associated with TraumaNetzwerk DGU®, however, the entry of at least a basic data set is obligatory for reasons of quality assurance. The present study is in line with the publication guidelines of the TraumaRegister DGU® and registered as TR-DGU project ID 2012-011.

Inclusion and exclusion criteria

The aim of the analysis was to evaluate the effect of preclinical values substation in potentially bleeding elderly trauma patients. Therefore we investigated patients above the age of 60 years with an ISS > 16 [18] and a reported prehospital systolic blood pressure below 100 mmHg. We excluded patient with a prehospital blood pressure below 60 mmHg assuming this patients being in extremis with a very high mortality. Finally we excluded patients with a very severe blunt brain injury (AIS head 4 and 5 points) because it is generally accepted, that patients with a severe traumatic brain injury demand higher systolic blood pressure to avoid secondary brain injury.

Patients were selected for this study according to the following criteria:

- Primary admission to the hospital (no transfers).
- Injury Severity Score (ISS) ≥ 16.
- Age ≥ 60 years.
- Abbreviated Injury Scale Head ≤ 3 [19].
- Systolic blood pressure at the accident site between 60 and 100 mmHg.
- Data available for prehospitally administered fluid volume, haemoglobin concentration on hospital admission and blood pressure at the accident site and upon hospital admission.

Matched-pairs analysis

According to the prehospitally administered fluid volume (crystalloids plus colloids), patients were divided into a "low-volume" (0–1000 ml) and a "high-volume" (>1000 ml) group. The mean amount of administered volume of all patients that met the inclusion criteria was 1340 ml (808.6 ml–1871.8 ml). To evaluate the effect of prehospital volume administration, patients with high- and low-volume fluid replacement were matched according to the following criteria:

- Pattern of injury for the following five body regions: head, thorax, abdomen, face, and extremities, including the pelvis, where matching criteria were Abbreviated Injury Scale (AIS) severity ≥ 3 points.
- Total ISS groups were matched with the following range: (1) 16–24; (2) 25–34; (3) 35–49; (4) ≥ 50.
- Systolic blood pressure at the accident site had to be between 60 and 100 mmHg and was subdivided into two groups that matched the following values: (1) 60–89 mmHg and (2) 90–100 mmHg.
- Ground or air transport.
- Gender.
- Intubation (yes/no).