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Single centre experience of combat-related vascular injury in victims of Syrian conflict: Retrospective evaluation of risk factors associated with amputation

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ABSTRACT

Objective: To elucidate the risk factors associated with amputation in cases with combat-related vascular injury (CRVI).

Material and methods: This retrospective study included 90 cases with CRVI treated between May 2011 and July 2013. The patients were divided into group I ($n = 69$), in which the limb was salvaged and group II ($n = 21$), in which the patients received amputation.

Results: The overall and the secondary amputation rates were 23% and 18%, respectively. There were no amputations with the MESS of nine or less, increasing proportions of amputations at 10 and 11, with a level of 12 leading to 100% amputation rate. The mortality rate was 2%. Among the 52 (58%) cases with the mangled extremity severity score (MESS) ≥ 7, the limb salvage rate was 60%. The patients in group II were more likely to have a combined artery and vein injury ($p = 0.042$). They were also more likely to be injured as a result of an explosion ($p = 0.004$). Along with the MESS ($p < 0.001$), the duration of ischemia (DoI) ($p < 0.001$) were higher in group II. The rate of bony fracture ($p < 0.001$) and wound infection ($p = 0.011$) were higher in group II. For the overall amputation, the odds ratio of the bony fracture (OR: 61.39, $p = 0.011$), nerve injury (OR: 136.23, $p = 0.004$), DoI (OR: 2.03, $p = 0.003$), vascular ligation (OR: 8.65, $p = 0.040$) and explosive device injury (OR: 10.8, $p = 0.041$) were significant. Although the DoI ($p < 0.001$) and the MESS ($p = 0.004$) were higher in whom a temporary vascular shunt (TVS) was applied, the utilisation of a TVS did not influence the amputation rate ($p = 1.0$).

Conclusions: The DoI and the variables indicating the extent of tissue disruption were the major determinants of amputation. While statistically non-significant, the benefit of the application of a TVS is non-negligible. MESS is a valid scoring system but should not be the sole foundation for deciding on amputation. Extremities which were doomed to amputation with the MESS >7 seem to benefit from revascularisation with initiation of reperfusion at once. The validity of MESS merits further investigation with regard to the determination of a new cut-off value under ever developing medical management strategies.

Introduction

The capabilities of vascular surgeons to manage the wounded have been developing with significant advancements, which led to the extension of the management strategies of the casualties [1–11]. The aim of this study was to elucidate the risk factors associated with amputation in cases with combat-related vascular injury (CRVI) during the in-hospital course.

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Materials and methods

Study design and population

In this retrospective survey, the data was obtained from the medical records of Antakya State Hospital, Hatay, Turkey. The ethical approval (Protocol Nr: 1717-GOA) was taken under permission of the Ethical Committee of Non-invasive Clinical Research from Dokuz Eylul University Faculty of Medicine. The medical archive was searched between May 2011 and July 2013 for the victims of Syrian conflict who admitted or transferred to the Emergency Service (ES). Among the 105 admissions with vascular injury, 90 cases constituted the research population (Fig. 1). The patients were divided into two groups, in which the limbs were either salvaged (group I, $n = 69$) or amputated (group II, $n = 21$).

Study variables

On admission the demographics, the pattern of injury, the time of the occurrence of the injury and the medical attention that had been given were noted either from the case, from the relative and/or from the ambulance service squad. Along with the injury characteristics, the hard signs of vascular injury were recorded. Ninety cases with vascular injury were graded with the mangled extremity severity score (MESS) [8].

The injured vascular structures were noted. Usually, the greater saphenous vein (GSV) of the leg without injury was the graft of choice in both arterial (reversed fashion) and venous (non-reversed fashion) positions. In cases with a mismatch between the injured vessel and the GSV, a panel saphenous vein grafting was performed as described before [2]. In order to allow for damage control resuscitation and expedite reperfusion because of the borderline duration of ischemia (DoI), a temporary vascular shunt (TVS) (Javid^{TM}, Bard Ltd., West Sussex, UK) was utilised after an initial embolectomy as described in the Belfast approach [2]. All venous injuries above the popliteal and cubital level were repaired.

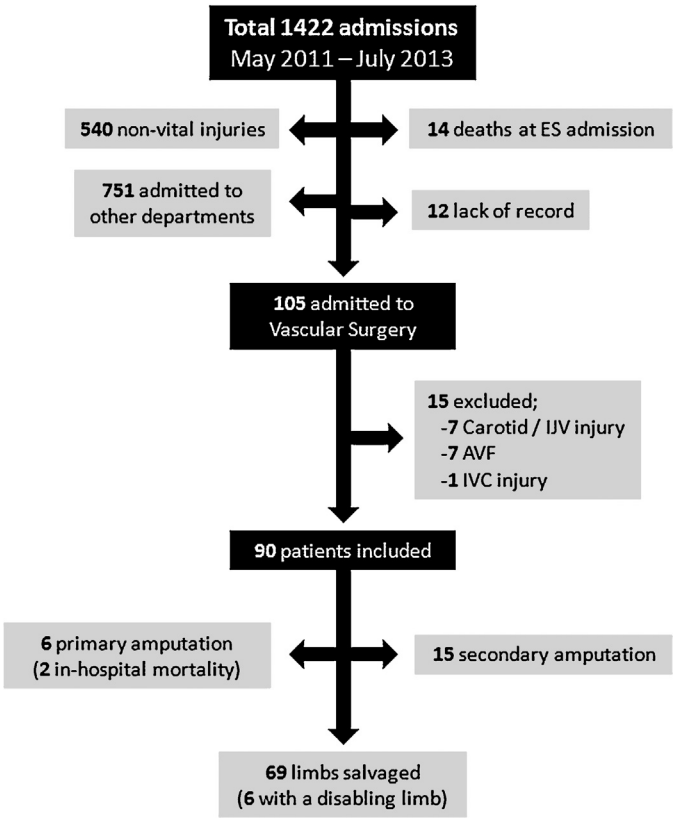

Fig. 1. Constitution of the study population with a brief summary of outcome. AVF: arteriovenous fistula, ES: emergency service, IJV: internal jugular vein, IVC: inferior vena cava.

While DoI was defined as the time between the occurrence of injury and the initiation of reperfusion, it was defined as the time between the occurrence of injury and admission to ES in primary amputees. The cases with vein injury alone were not included in the calculation of DoI. In all cases with the DoI of more than 6 hrs with or without a venous injury, a standard double-incision fasciotomy decompressing the four compartments in the calf or the two in the forearm was performed. A swipe sample for wound site culture was collected. During the period of delayed wound closure, wound care was assisted by a plastic and reconstructive surgeon by means of daily debridement of de-vital tissues, vacuum assisted closure, and/or tissue flap rotations.

Primary amputation was defined as the initial surgical procedure without any attempt for vascular reconstruction. Decision for primary amputation was made individually and based on the viability of the injured extremity. Additionally, besides the life-threatening condition of the case, the DoI, the impact of the blast effect and the MESS were significant while deciding on primary amputation [1,2,8,12]. The subsequent amputation after vascular reconstruction was defined as *the secondary amputation*.

Statistical analysis

Statistical analyses were performed through using Number Cruncher Statistical System (Kaysville, Utah, USA) version 2007. Continuous variables with normal distribution were presented as mean ± standard deviation, whereas variables without normal distribution were presented as median (minimum–maximum) values. For quantitative data, two groups were compared using Student t-test or Mann–Whitney U-test. For comparison of qualitative data Pearson Chi-square test with Yate's correction or Fisher's exact test were used. A forward logistic regression model was created through including independent variables, which had a significant influence on amputation in the univariate analysis. A p value of < 0.05 was considered as significant.

Results

There were 69 (77%) patients in group I and 21 (23%) patients in group II. Eighty-one (90%) of all cases, 60 (87%) cases in group I and all cases in group II were presenting hard signs of vascular injury on admission. Two of the primary amputees died due to multiorgan failure even after primary amputation (overall mortality rate 2%). The frequency of the MESS and the primary and secondary amputations were revealed in Fig. 2. There were 52 (58%) cases with the MESS ≥ 7, and the amputation rate among them was 40%. The overall, primary and secondary amputation rates were 23, 7, and 18% (15/84 cases), respectively. The extremity injury constituted the majority (86%) of vascular injuries (Fig. 1). The characteristics of cases in group I and II were revealed in Table 1. Forty-two (47%) cases were wounded by an explosive device. In comparison to group I, the cases in group II were older, had a higher MESS and DoI. Furthermore, the rate of injury due to an explosive device, the rate of wound infection, concurrent bony fracture, major nerve injury, and combined artery and vein injury were higher in group II. As for previous intervention applied in Syria, while the rate of vascular ligation was higher in group II, the rate of compression was higher in group I.

The median value of the MESS in the primary amputees and the others were 11.5 (11–12) and 7 (3–12), respectively. The median