



In adults with suspected crush injury, does the use of tourniquets or amputation improve morbidity and mortality?

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Shapiro, G.L. and Smith, E.R. (2013), 'The Facts and Details About Different Types of Tourniquets', *Journal of Emergency Medical Services*, 11(38).

A brief introduction...

Significant crush injuries are encountered uncommonly by pre-hospital clinicians in the UK.

Some express concern that removing the crushing force may precipitate toxic reperfusion and crush syndrome in the pre-hospital setting where it may be difficult to manage.

It has been proposed that amputating the limb or controlling reperfusion using a tourniquet could reduce this risk.

We sought evidence regarding how these strategies may impact morbidity and mortality searching the:

- CINAHL,
- EMBASE and
- Medline databases.

This yielded 367 articles for screening, 3 case reports were identified for inclusion.

The Results...

Anderson, J.L. et al., 2022, USA

Case report of a special forces sniper who sustained a crush injury.

Discussion proposed:

- Authors propose the use of tourniquet for pinned limbs prior to extrication.
- Hypothesising that delaying the reperfusion & systemic insult due to hyperkalaemia & myoglobin until it can be managed at a definitive care facility.

Dhir, K., et al., 2018, USA

Female patient developed crush injury from trapped arm. Upon release by EMS she arrested, believed to be due to hyperkalaemia. No tourniquet was used.

Discussion proposed:

- Benefit of delaying reperfusion with a tourniquet until definitive care outweighs the risks.
- Raised the question if a tourniquet had been used in this case, could the arrest have been prevented.

Badar, J. et al., 2015, USA

Male patient crushed by heavy machinery. Bilateral tourniquets applied to legs to prevent reperfusion.

Upon release of tourniquets in hospital, patient experienced sudden cardiac dysrhythmias. This was treated & patient made a full recovery with full limb function.

Discussion proposed:

- Due to limited pre-hospital resources, containment of toxins in limbs enable haemodynamic stability until definitive care.
- Tourniquet risks of nerve palsies and necrosis are outweighed by the benefits.

Discussion...

Research into the use of arterial tourniquets for the management of crush syndrome is limited to a handful of individual case studies, as seen here. It would seem from these cases that patients have the potential to rapidly deteriorate due to hyperkalaemia so it would make hypothetical sense to contain said toxins in the crushed limb until the secondary effects can be better managed in a hospital setting.

The side effects associated with tourniquet use are likely a significant factor as to why this management strategy is not routine in practice today. The research here suggests, such side effects are outdated and overstated. In a casualty with crush syndrome with a prolonged extrication, their limb will already be ischaemic and the potential benefit of reducing adverse outcomes including cardiac arrest upon release, outweighs any threat to limb. Further research, ideally in the form of randomised control trials, is required to fully evaluate the risk-benefit of tourniquet use in this setting. However due to the small incidence of crush injuries and crush syndrome particularly in developed countries, the feasibility of such studies would be challenging.

No studies investigated amputation as a prophylactic measure to prevent reperfusion in the pre-hospital setting. Sever and Vanholder (2012) said in their research that amputations should not be performed to prevent crush syndrome, only as a last resort if the limb is not salvageable or it's required for a rapid extrication if the patient's safety is at imminent risk.

The Bottom Line...

There are no published articles collecting objective data to support or confute the use of tourniquets to delay reperfusion and the subsequent adverse effects of this. The only available data are individual case reports. As such, the use of tourniquets in the prehospital management of patients suffering a crush injury cannot be routinely recommended. The collection of objective data is required to facilitate further understanding of the risk-benefit of tourniquets in the crush injury patient and subsequently discussion of their potential use.

Amputation was not advocated prophylactically to prevent reperfusion, only as a last resort if patient safety is at imminent risk, there is prolonged injury time or expected extrication or if the limb is clearly not salvageable.

References:

- Anderson, J.L., Cole, M. and Pannell, D. (2022) 'Management of Severe Crush Injuries in Austere Environments: A Special Operations Perspective', *Journal of Special Operations Medicine*, 22(2), pp. 43-47.
- Badar, J., Schwartz, D.S. and Weisner, Z. (2015) 'Immediate Lower Extremity Tourniquet Application to Delay Onset of Reperfusion Injury after Prolonged Crush Injury', *Prehospital Emergency Care*, 19(4), pp. 544-547.
- Dhir, K., Ferguson, J.D., Spangler, J.D., Whiffin, A.N.H. and Zhang, R. (2018) 'Bathroom Entrapment Leading to Cardiac Arrest From Crush Syndrome', *Prehospital Emergency Care*, 23(1), pp. 90-93.
- Sever, M.S. and Vanholder, R. (2012) 'Recommendations for the management of crush victims in mass disasters', *Nephrology Dialysis Transplantation*, 27(1), pp. 11-27.