

# The Use of Tourniquets for Haemorrhage Control

## Guidance Notes for Trainers

*Notes adapted from a presentation by Dr Matt Ladbrooke, Remote Emergency Care Trainers' Day, April 2009.*

### Background

The use of tourniquets in haemorrhage control has for many years been taught as a high-risk method of saving life over limb. Following widespread military use in the Iraq and Afghanistan campaigns, this school of thought is changing, and military experiences are impacting on pre-hospital practice in wilderness and street EMS.

Haemorrhage control can be achieved by:

- Direct pressure, elevation, rest, splints
- Indirect pressure
- Tourniquet
- Advanced dressings – HemCon® and QuikClot®
- Recombinant factor VIIa

Direct pressure, elevation, rest, time, indirect pressure and prevention of hypothermia<sup>1</sup> remain the primary methods of haemorrhage control. However, the tourniquet is no longer thought of as a tool of last resort.

### Indications for tourniquet use

- Limb injury
  - Tourniquets can only be used on limbs
- To buy time
  - Mass casualty or multiple injury
  - Apply as a temporary measure in order to allow time to attend to higher priority patients or injuries within the same patient
- To save time (scoop and run)
  - Where definitive medical care is close by
- Provide direct pressure?
  - When applied loosely
- When the limb cannot be seen / entrapment
  - Until an examination of the distal limb can be made to ascertain the extent of injury

### Principles of tourniquet use

- Avoid improvisation
  - Only a recognised tourniquet device such as the Combat Action Tourniquet should be used – successful improvisation is extremely difficult
- Single bone compartments
  - The blood vessels likely to be responsible for a major bleed run between the bones in double bone compartments (e.g. lower arm and lower leg) – therefore a tourniquet is unlikely to be successful
- Avoid joints
- On sound tissue
  - Do not apply over the wound
- Tight enough to stop bleeding
- Label the casualty
  - Clear markings on the patient's forehead
- Tell the next carer
  - Good handover required
- Correct triage category
  - Automatically assign patient to most urgent triage category

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<sup>1</sup> Hypothermic blood does not clot as effectively as blood at normal body temperature.

## Tourniquet time

| Shortest time | Changes in muscle and nerve physiology, and consequence             |
|---------------|---|
| ½ hr          | Earliest nerve damage   |
| 1 hr          | No distal muscle damage, but muscle under the tourniquet is damaged |
| 1.5 – 2 hr    | Surgical guideline <sup>2</sup>                                     |
| 2 hr          | Surgical maximum, muscle damage                                     |
| 3 hr          | Muscle death  |
| 6 hr          | Amputation above the tourniquet                                     |

### Pain

In an experiment performed on awake volunteers, tourniquets were applied at a pressure calculated to completely prevent blood flow past the tourniquet. The maximum tolerated times were:

- Forearm 25 minutes
- Upper arm 18 minutes
- Lower limb 30 minutes

Analgesia is extremely important for patients with a tourniquet, and should be initiated as soon as possible after (or before, if appropriate) application. Morphine analgesia should be used where available, or the most potent available alternative.

### Reperfusion

There used to be a recommendation that tourniquets were intermittently loosened to allow temporary blood flow to the limb, the theory being that this would reduce the resultant tissue damage. However studies have shown that the tourniquet would have to be released for at least 30 minutes to effectively reperfuse the tissue, which would be impractical in a case where a tourniquet was required to stop bleeding. One potential solution would be to apply two tourniquets next to each other, and alternately tighten and loosen each one. As the *tourniquet time* table above indicates, the greatest damage is done to the tissue directly below the tourniquet and alternating release and tightening of two tourniquets will therefore theoretically reduce the damage done.

### Tourniquet removal

In the following circumstances the tourniquet should **stay on**:

- The patient is in shock
- The clinical situation is unstable
- Resources are limited
- The patient has suffered an amputation

Having loosened the tourniquet, in the following circumstances the tourniquet should be **retightened**:

- Significant bleeding despite a pressure dressing
- Significant bleeding whose onset is delayed<sup>3</sup>

### Ischaemia-perfusion injury

This describes systemic (whole-body) injury due to metabolic (acid-base) changes following release of the tourniquet. Lactic acid and free radicals are built up distal to the tourniquet and released into the rest of the body on release of the tourniquet. Potassium build-up (hyperkalaemia) is also extremely toxic, particularly to the heart, causing arrhythmias. Steps to minimise the risk

<sup>2</sup> Tourniquets are routinely used in surgery to prevent bleeding interfering with the surgeon's view of the operation site.

<sup>3</sup> Onset of bleeding may be delayed if a clot is dislodged or if clotting factors become 'used up' during major blood loss.

of ischaemia-perfusion injury are:

- Reduce the amount of ischaemic tissue (the tissue starved of blood supply distal to the tourniquet) by appropriate tourniquet position and pressure
- Minimise tourniquet time
- Support the circulation (fluid therapy, body temperature control, oxygen etc)

### **Post tourniquet syndrome**

This recognised consequence of tourniquet use leaves the patient with weakness, paraesthesiae (pins and needles), pallor and stiffness in the affected limb. It usually resolves in around 3 weeks.

### **Difficulties with pressure dressings**

Pressure dressings (the main alternative to a tourniquet) are not simple to apply, often requiring two medics for a successful application, require the proper equipment to be present, may not work effectively, particularly in cases of partial or complete amputation where the bleeding vessels are difficult to access, and need frequent reassessment.

### **Training levels**

It is recommended that tourniquet use be taught as part of the **level 4 core content**. The trainer should pay particular attention to the following elements of their use:

- Indications for use
- The need for use of a proper commercial tourniquet rather than improvisation
- Correct technique for placement
- Patient support including triage categorisation, analgesia, body temperature and circulatory support
- Indications for removal
- Complications of tourniquet removal including ischaemia-reperfusion injury

At level 2 tourniquets may be mentioned as a higher-level technique (in a similar way to mentioning C-spine collars, but not teaching their use). Questions should be answered accurately, but trainers should avoid giving the impression that students will be appropriately trained at this level to safely use a tourniquet.