

## Tourniquets, Pressure Points, and Extremity Hemorrhage

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General Albert Sydney Johnston, shot from behind unintentionally by one of his own men armed with an Enfield rifle, exsanguinated and died within 30 minutes from a wound to his right popliteal artery. In the general's uniform pocket was a field tourniquet. Its use could have changed world history. The battle of Shiloh, in 1862, was a Northern victory because of Johnston's untimely loss in the afternoon of the first day of the 2-day battle.<sup>1</sup> Fifty years later the Boy Scouts of America, still in its infancy, described the cloth and windlass tourniquet, its indication and its application with succinct clarity<sup>2</sup> that flies in the face of apparent current confusion over control of extremity hemorrhage.

The most comprehensive and objective review of the literature, concerning tourniquets and "pressure points" was published in *Circulation* (2005). It concluded, "There is insufficient evidence about effectiveness, feasibility and safety of tourniquets to recommend for or against their use by first aid providers to control bleeding,"<sup>3</sup> furthermore, "... the efficacy, feasibility and safety of the use of pressure points to control bleeding have never been subjected to any reported study."<sup>3</sup>

The most recent addition of *Emergency War Surgery* (2004) advocates under, "Hemorrhage Control, Extremity injury, point compression of the proximal artery, may require compression at the pressure point for up to 20 minutes to provide hemostasis."

"A tourniquet should be applied . . . (may be the first choice in combat) . . . if previous techniques fail . . . (and) . . . should be placed on the upper arm or thigh where the artery may be more easily compressed."<sup>4</sup>

The wars in Iraq and Afghanistan have provided the largest series of tourniquet use to control extremity hemorrhage ever recorded, thanks to the efforts of COL John F. Kragh, MC USA. Tourniquet use has been described as eminently successful in saving the lives of wounded soldiers and civilians. The most recent report<sup>5</sup> analyzes 862 tourniquets applied to 651 limbs of 499 patients (87% survival). Single tourniquets were used on 445 limbs. Nearly a third of the limbs were treated with multiple tourniquets, two, three, four, even five per limb! Needed are the results of the surgery provided to these patients since tourniquets are used for control of arterial bleeding from arterial injury.

Questions which must be answered concern: optimal tourniquet selection, use below elbow and knee, management of pain and usefulness of so-called "pressure points." In a recent publication,<sup>6</sup> we addressed these questions in healthy adult volunteers. We studied three tourniquets in 10 subjects. Tourniquets were placed on arm, forearm, thigh, and leg. Success was defined as cessation of distal arterial pulse, measured with Doppler ultrasound at wrist or ankle, sustained for 60 seconds. The three tourniquets: cloth with windlass, sphygmomanometer, and half-inch rubber tubing were all successful in all four positions with notable exceptions: thighs of two subjects were too large for the sphygmomanometer; one subject experienced test terminating pain with application of the half-inch rubber tubing on thigh and leg; one subject experienced test terminating pain with the cloth and windlass on thigh. The cloth with windlass was the simplest tourniquet to improvise and apply. We concluded that pain was a potential consequence of tourniquet use, but that it was less likely in the severely traumatized patient, where, even if accompanying tourniquet use, it was preferable to tourniquet nonuse. We observed attempts to arrest distal arterial pulses with "pressure point control" of brachial artery (arm, cubital fossa), femoral artery (groin), and popliteal artery (popliteal fossa) were unpredictable and unsustainable in 10 of 10 subjects. The latter phenomenon is a result of the well-known, extensive collateral arterial blood flow about elbow and knee. We selectively studied the combat application tourniquet, the uniform belt (US military), and the Israeli tourniquet (with windlass) and observed that all were effective in all positions.

We concluded that the cloth with windlass tourniquet was the most easily devised in an emergency, if one was not already issued (combat application tourniquet), that it could be used just as effectively below the elbow and knee as above those joints, thus avoiding their unnecessary sacrifice. We recognized that pain was a potential complication of tourniquet use but that the old saying, "Better to be in pain than interred," would apply should pain perception be intact and pain medication be unavailable. Lastly, we concluded that "pressure point control" of distal arterial blood flow, and hence arterial hemorrhage from an extremity wound, is a euphemistic misnomer.

Two final notes of caution deserve mention: if more than one tourniquet is required to control arterial hemorrhage from an extremity wound, the first tourniquet was not properly applied; and a tourniquet is indicated only for control of arterial hemorrhage, which means surgical treatment is indicated,

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usually in the operating room. Hence collection of data concerning all such use of tourniquets should include information as to the artery injured, the care required, and the ultimate outcome.

### REFERENCES

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