



PNEUMATIC TOURNIQUET

Cochrane Database of Systematic Reviews for meta-analyses, systematic reviews, randomized controlled and non-randomized trials, guidelines, and case reports. Search terms included *pneumatic tourniquet, tourniquet safety, tourniquet, surgical hemostasis, surgical procedures, nursing care, perioperative care, patient positioning, compartment syndromes, arm injuries, leg injuries, hand injuries, pain measurement, peripheral nervous system, peripheral nervous system diseases, nerve palsy, metabolic phenomena, metabolic changes, metabolic effects, vital signs, respiration, carbon dioxide, intracranial pressure, oxygen consumption, cardiac output, acidosis, hyperemia, venous congestion, blood pressure, lactic acid, hemodynamics, pulse, hypothermia, hyperthermia, systemic inflammatory response, Esmarch bandage, Urias bag, Pomidor roll-cuff, bandage, elastic wrap, intravenous regional anesthesia, Bier block, ankle block, conduction anesthesia, bloodless field, occlusion pressure, ischemia, and reperfusion injury.*

The search was limited to articles published in English between January 2006 and February 2012. The search was expanded to include articles published before 2006 when the original search did not identify more recent literature on a particular topic. The librarian established continuing alerts on the pneumatic tourniquet topics. The lead author and librarian identified relevant guidelines from government agencies and standards-setting bodies.

Articles identified in the search were provided to the lead author and a doctorally prepared evidence appraiser for evaluation. Each article was reviewed and critically appraised using the Johns Hopkins Evidence-Based Practice Model and the Research or Non-Research Evidence Appraisal Tools as appropriate. The literature was independently evaluated and appraised according to the strength and quality of the evidence. Each article was then assigned an appraisal score as agreed upon by consensus of the lead author and evidence appraiser. The appraisal score is noted in brackets after each reference, as applicable.

The collective evidence supporting each intervention within a specific recommendation was summarized and used to rate the strength of the evidence using the AORN Evidence Rating Model. Factors considered in review of the collective evidence were the quality of research, quantity of similar studies on a given topic, and consistency of results supporting a recommendation. The evidence rating is noted in brackets after each intervention.

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Recommendation I

The perioperative registered nurse (RN) should assess the patient preoperatively for risks and potential contraindications related to the use of a pneumatic tourniquet.

Risks related to the use of a pneumatic tourniquet include nerve injuries,^{1,3} skin injuries (eg, blistering, bruising, necrosis),^{1,6} compartment syndrome,¹ DVT,^{1,3} and pain.⁴ When a pneumatic tourniquet is used on a patient's extremity, the patient may experience systemic responses (eg, changes in temperature or blood pressure) related to reperfusion upon cuff deflation.^{4,5} Using a pneumatic tourniquet on patients who have preoperative conditions that predispose them to these risks may result in a cumulative effect.

I.a. The perioperative RN should not assume routine use of a pneumatic tourniquet for all extremity procedures. The RN should confirm in the surgeon's or anesthesia professional's plan of care whether a pneumatic tourniquet will be used. [1: Strong Evidence]

The surgeon or anesthesia professional determines whether to use a tourniquet based on the risks and benefits to the patient. There is debate in the medical community regarding the use of a pneumatic tourniquet for surgical procedures. Based on the evidence, routine use of a pneumatic tourniquet for limb occlusion can no longer be assumed. Findings from an e-mail survey sent to 1,665 foot and ankle surgeons in North America revealed that 11 respondents (3.4%) rarely or never used a tourniquet.³

One researcher used a randomized controlled study to explore tourniquet use in patients undergoing arthroscopic knee surgery. Comparing the outcomes of 56 patients who were assigned either to the control group or the intervention group, the researcher found no significant differences related to operative times, technical difficulties, identification of intra-articular structures, postoperative pain, or postoperative complications when a tourniquet was not used. The researcher suggested the use of a tourniquet may be unnecessary for arthroscopic knee surgery.⁷

Findings from another prospective randomized controlled trial also revealed that knee arthroscopy could be performed successfully without the use of a tourniquet. In this study, tourniquets were applied to all of the 109 patients who participated, with 58 patients assigned to a group that had the tourniquet inflated and the other 51 assigned to a group that did not have the tourniquet inflated. The operative view was rated poor by the surgeon in four procedures (7.8% of procedures performed) in the uninflated tourniquet group, requiring those tourniquets to be inflated for 5% to 60% of the procedure time. The mean procedure time was 27 minutes for the inflated tourniquet group (ie, range 10 minutes to 80



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technical difficulties during upper limb surgery may have been reduced when tourniquets were used. However, they were not able to determine whether pain perception or operative time was influenced by the use of a tourniquet. They recommended further studies with stronger methodology.¹⁵

In another study, researchers followed 138 patients for at least one year after their surgical procedures to repair tibial fractures. The patients were randomly assigned to one of two groups (ie, with or without tourniquet use). The researchers reported that use of a tourniquet did not influence the infection rate or the healing time. They did report that patients' perceptions of pain decreased when a tourniquet was not used. They suggested that a tourniquet may not be necessary when plating tibial fractures because the surgical repair can be a short procedure that does not typically involve severe bleeding.¹⁶

- I.b. The perioperative RN should assess the patient for considerations related to tourniquet use, including

- planned location of the tourniquet,
- condition of skin under and distal to the planned cuff site,
- size and shape of the extremity, and
- peripheral pulses distal to the cuff.

[2: Moderate Evidence]

Preoperative skin assessment provides a baseline to evaluate skin injuries that may occur at the site of the tourniquet cuff because of pressure necrosis or friction burns. Applying the tourniquet cuff to the proximal portion of the limb in an area of the limb where there is the most soft tissue can help to decrease the risk of injury to underlying nerves and vessels.³

Preoperative patient assessment facilitates planning for tourniquet cuff selection. There is a direct correlation between the circumference of the limb at the site of cuff application and the cuff pressure required to suppress circulation. Large limb circumferences indicate a higher tourniquet pressure will be necessary to achieve vessel occlusion.¹⁷ Patients with small limb circumferences (eg, children younger than two years, small adults) will require a tourniquet cuff specifically designed for this patient population.^{18,19}

Preoperative assessment of the limb shape also helps to plan for the selection of a properly fitting tourniquet cuff (eg, straight-cylindrical versus wide-contour cuff).²⁰ The risk of the tourniquet cuff shifting may be increased when the patient is obese or has limb tissue that is loose.²¹

Preoperative assessment of the patient's circulatory system including a baseline measurement of peripheral pulses helps to evaluate the risk of applying a tourniquet to the patient's limb. Indicators of poor circulatory nutrition include brittle, dry nails; shining or scaly skin;

and extremity hair loss. Other indicators for circulatory considerations include capillary filling time and the presence of varicose veins.²²

I.c.

The nursing assessment should include screening for potential contraindications for tourniquet use, including

- venous thromboembolism,^{2,3,23-27}
- impaired circulation or peripheral vascular compromise,^{17,27-29}
- previous revascularization of the extremity,^{22,30}
- extremities with dialysis access (eg, arteriovenous grafts, fistulas),²²
- acidosis,³¹
- hemoglobinopathy (eg, sickle cell anemia),^{17,28,32,33}
- extremity infection,¹⁷
- tumor distal to the tourniquet,¹⁷
- medications (eg, antihypertensives)^{35,36} and supplements (eg, creatine),³⁷
- history of pain³⁸ or weakness³⁹ in muscles or bones in extremities,
- open fracture, and
- increased intracranial pressure.^{2,3,24}

[2: Moderate Evidence]

Risk of complications may be higher for certain patient populations. Using a 17-item questionnaire delivered by e-mail, researchers conducted an investigation to determine current practice patterns among members of the American College of Foot and Ankle Surgeons. A total of 317 respondents reported that the most commonly listed contraindications to tourniquet use included vascular disease or previous bypass and DVT.⁴

Researchers conducting a prospective comparison study examined the outcomes of 48 consecutive patients undergoing total knee arthroplasty and reported that the incidence of DVT was high (81.3%) with or without the use of a tourniquet. The first group of 21 patients underwent the surgical procedure without a tourniquet, and the next 27 patients underwent a tourniquet-assisted procedure. The researchers concluded that the use of a tourniquet decreased perioperative blood loss and did not increase the risk of DVT. They identified symptomatic pulmonary embolism in 1.7% of the patients and emphasized the importance of prevention and early detection of DVT to decrease the risk of fatal pulmonary thromboembolism.²⁴

Twenty patients participated in a prospective study to determine whether extramedullary guided total knee arthroplasty decreased the severity of embolic showers after tourniquet deflation. The researchers reported that 14 patients experienced large venous emboli and six patients experienced small venous emboli. The researchers concluded that the thrombogenic effect of the tourniquet may be the cause of venous emboli rather than the manipulation of the marrow cavity because they did not find a difference in the incidence of venous emboli