



REVIEW ARTICLE

# Safety of tubeless or totally tubeless drainage and nephrostomy tube as a drainage following percutaneous nephrolithotomy: A comprehensive review



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**Summary** Percutaneous nephrolithotomy (PCNL) using a nephrostomy tube as a drainage has been considered the standard procedure. However, recently many literatures have reported the use of tubeless and totally tubeless drainage following PCNL with excellent results. A literature search was conducted using MEDLINE databases to review each drainage technique following PCNL (tubeless, totally tubeless, or nephrostomy tube) and also to assess the most recent evidence that compare the safety of these drainage procedures with a clear-cut clinical parameter imposed. Tubeless or totally tubeless PCNL is significantly superior to standard PCNL in terms of length of hospital stay, postoperative pain (visual analog scale) score, demands or dosage of analgesics required, as well as faster return to activity for the patients. However, despite the many advantages of tubeless or totally tubeless PCNL over standard PCNL, there are a number of situations requiring the consideration of nephrostomy tube placement. Nonetheless, decision to use or not to use nephrostomy tube after PCNL depends on the surgeon's experience and clinical judgment.

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## 1. Introduction

Percutaneous nephrolithotomy (PCNL) has been recognized as the primary treatment of choice for patients with a large kidney stone.<sup>1</sup> Development of techniques to establish safe and reliable percutaneous kidney access triggered the growth of percutaneous intrakidney procedures. Rupel and Brown<sup>2</sup> reported the removal of a kidney stone via an established nephrostomy tract in 1941.<sup>3</sup> However, it was much later, in 1976, that PCNL gained its popularity when Fernstrom and Johansson<sup>4</sup> performed the removal of a kidney stone percutaneously.<sup>3</sup>

The insertion of a nephrostomy tube after PCNL as a drainage is still considered a standard procedure. Other than acting as drainage, a nephrostomy tube placed after PCNL is also meant to serve as a medium to tamponade bleeding along the PCNL tract. Furthermore, it also provides access to perform a second exploration and percutaneous chemolitholysis if necessary.<sup>5</sup> However, the recent literature suggests that the use of tubeless or totally tubeless drainage following PCNL also presents excellent results. This leads to some confusion about which procedure should be performed as a drainage following PCNL to ensure the patient's safety and comfort.

The objective of this review is to re-explore each drainage technique following PCNL (tubeless, totally tubeless, or nephrostomy tube) and also to assess the most recent evidence that compare the safety of these drainage procedures with a clear-cut clinical parameter imposed.

## 2. Methods

A literature search was conducted on MEDLINE databases using the following keywords: stone, percutaneous nephrolithotomy, tubeless, and nephrostomy. Using these keywords, a long list of 205 references was available. No language restrictions were applied, but the search for evidence was restricted to studies conducted within the past 5 years with full text readily available, leading to the retrieval of a total of 32 citations. A quick skim through the abstracts of all citations was performed to ensure relevance to this particular review.

## 3. Results and discussion

### 3.1. Standard/nephrostomy tube PCNL

A nephrostomy tube is a tube placed in the renal collecting system for the purpose of drainage, diagnostic test, and/or removal of calculi. It drains urine directly from the kidney into a collecting bag outside the body. A nephrostomy tube may be placed through the percutaneous route or during an open surgical procedure. In urology, nephrostomy tubes are routinely used after PCNL. The use of percutaneously placed nephrostomy tubes was initially described in 1955<sup>6</sup>, where the operator passed various sizes of polyethylene tubing over 10–14 G needles.

The first nephrostomy tube described, a 14Fr rubber catheter, had been used as a splint for open intubated ureterotomy in the previous decade.<sup>7</sup>

Nephrostomy tubes that are commonly used are available in various sizes (5Fr–32Fr) and types (Foley, Malecot, Council, Cope loop, reentry tube, pigtail catheter, etc.).<sup>8</sup> Traditionally, 20–24Fr tube nephrostomy drainage has been advocated after PCNL with the aim of providing reliable urinary drainage, hemostatic tamponade of the percutaneous renal tract, and maintaining access for future percutaneous manipulations.<sup>9</sup> Therefore, the placement of a nephrostomy catheter after PCNL is considered as the standard procedure.<sup>10</sup>

The procedure begins by placing the patient in a prone position under general anesthesia. After performing retrograde ureteral catheterization, percutaneous renal access is obtained under ultrasound guidance. The tract is then dilated under fluoroscopic guidance, and calculus disintegration subsequently follows. After confirming complete calculus disintegration, a nephrostomy tube is usually placed in the percutaneous renal tract.<sup>9</sup>

Percutaneous nephrostomy was initially introduced for emergency drainage of an obstructed upper urinary tract. More recently, this procedure has also been used in the treatment of sepsis aggravated by ureteral obstruction. Additionally, a nephrostomy tube also helps assess potential recovery of renal function of an obstructed kidney and serves as an initial preparation before performing interventional dissolution and basketing of renal calculi.<sup>8</sup> In patients with upper urinary tract obstruction, relief of obstruction is usually achieved by insertion of a percutaneous nephrostomy tube, placed under local anesthesia, before establishing the definitive diagnosis and treatment of obstruction.<sup>11</sup>

Each nephrostomy tube has unique characteristics that may optimize its use in a given clinical setting. Regardless of its specific purpose, an ideal nephrostomy tube should have excellent biocompatibility and strength, be well tolerated by the patient, resist obstruction or dislodging, and be simple to insert and replace.<sup>7</sup> The indication for the placement of a nephrostomy tube depends on the advantages of each tube. Pigtail is the best choice in the drainage of an obstructed system. Balloon, Malecot, and tubeless types can be used in patients with uncomplicated PCNL. However, in problematic PCNL cases, Council or Kaye tamponade is recommended.

Nephrostomy tube insertion after PCNL also has other benefits, such as improving clearance of blood and thus preventing clot formation, maintaining the re-entry tract for a staged procedure, and performing contrast study in the postoperative period. No single tube of the available alternatives has all these advantageous properties. The possible disadvantages of nephrostomy tube placement are patient discomfort, pain, and prolonged hospitalization.<sup>12</sup>

### 3.2. Tubeless or totally tubeless PCNL

Nowadays, PCNL is still the main option for the treatment of large and complex renal stones. Standard PCNL consists

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