Retained Urine Volume and Bacteriuria in Traditional vs Vented Urine Drainage Systems

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ABSTRACT

Catheter Associated Urinary Tract Infection (CAUTI) is one of the most frequent hospital-acquired infections. Prolonged indwelling urinary catheterization is the primary risk factor for hospital acquired urinary tract infection. Because of the frequency in which individuals develop UTIs in the United States (greater than 1 million/year), decreasing the incidence by even 1% would help a large number of people. A potential source of risk for developing UTI is retained urine volume in the bladder. This risk translates directly into CAUTI risk for catheterized patients with undrained dependent loops in urinary catheter drainage tubing which may predispose to retained urinary volume. The addition of a back pressure relief vent to the catheter tubing may prevent catheter associated retained volume and thus reduce incidence of CAUTI. We propose to investigate if such an addition actually reduces retained urine volumes and CAUTI risk among catheterized patients in the hospital setting.

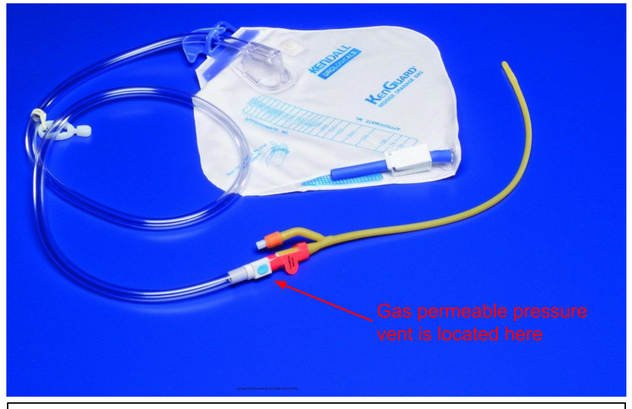

Figure 1: A conventional non-vented Foley catheter and urine drainage system. The red arrow marks the location of the gas permeable vent on vented drainage systems. The vent allows air under pressure in the tubing to escape the system rather than cause back pressure, and potentially excess retained urine volume, in the patient's bladder.

Citations

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INTRODUCTION

Catheter Associated Urinary Tract Infection (CAUTI) is the most frequent hospital-acquired infection[1]. Urinary tract infections account for 40% of all hospital-acquired infections[2]. About 80–90% of hospital-acquired UTIs are caused by urinary catheters[3]. Patients with long-term indwelling catheters stand an almost 100% chance of acquiring bacteriuria or a urinary tract infection[4]. CAUTI has such a high incidence (>1M/yr in the US) that even an intervention offering a small decrease in risk would have a large impact. Urine-filled dependent loops are thought to be a potential CAUTI risk factor and are commonly observed in urine drainage tubing.

Drainage tubing channels urine from a urinary (Foley) catheter inserted in a patient's bladder to a urine collection bag as in Figure 2. In a prospective study on 850 newly-catheterized patients published in 1999, Maki et al[5] found that "The only catheter-care violation predictive of an increased risk of CAUTI was a drainage tube sagging below the level of the collection bag."; the odds ratio for CAUTI with the drainage tube position below the level of the collection bag was 2.1 ($P<0.03$)[5].

In a summer 2011 prevalence study of urine drainage systems at intensive care units in our tertiary care hospital, the majority (85%) of observed urine drainage systems contained dependent loops in the drainage tubing. In turn, most (93.8%) of the dependent loops contained urine and 65.3% of those cases having a difference in urine meniscus height indicative of urine drainage system back pressure on the bladder. These survey results suggest that approximately half of catheterized patients in the ICU setting have some amount of drainage system back pressure. One way in which manufacturers have attempted to improve forward flow with the collection system is to vent the urinary drainage system to prevent trapped air on the patient side of a urine-filled dependent loop from causing back pressure on the bladder and improve flow dynamics and bladder emptying.

CONCLUSIONS

While the study as described is yet to be performed, bench-top experimentation with vented urine drainage systems suggests that under ideal circumstances they effectively vent trapped air in the drainage tubing and prevent bladder back pressure. The primary questions to be answered in this study are whether vented drainage systems perform as well in real clinical use, and if so whether prevention of urine drainage back pressure actually results in measurable reductions in risk of CAUTI.

MATERIALS AND METHODS

The study described in this poster is proposed research as manufacturer supplied Foley catheter and drainage systems to be studied have not yet been provided. The following is a description of proposed study methods.

Inclusion criteria for the study include: the requirement for Foley catheter placement for greater than 24 hours, clear urine without evidence of particulate matter (calculi, sediment, clot), and recorded urine output of at least 25ml/hr. Exclusion criteria include: unstable renal function, bandaged postoperative suprapubic incisions, or any anatomical deformity that precludes appropriate suprapubic access.

Patients will be randomized into either receiving a conventional non-vented Foley typically used at our institution or a vented Foley catheter. Bladder volumetric measurements will be performed by ultrasound scan before first ambulation after sleep. The difference (ΔH) in meniscus height (including zero difference) will be measured.

Retained urine volume will be measured directly by US bladder scan each morning that the patient has an indwelling urinary catheter. A daily urine dipstick analysis will be performed on study participants to determine presence of bacteriuria. Additionally thigh circumference close to the pubic region will be measured to determine possible correlation with flooded (non-functioning) Foley vents.

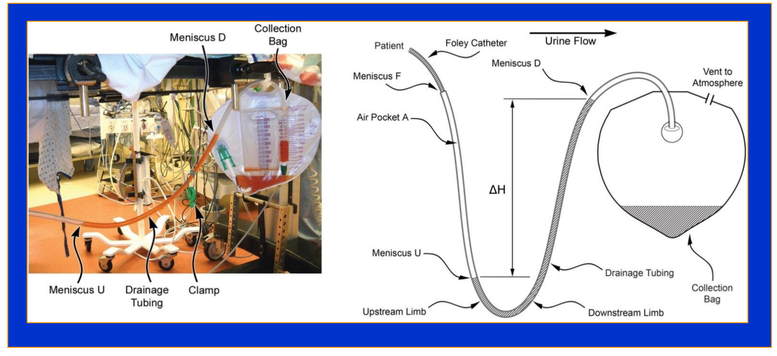

Figure 2: A photograph and schematic depiction of a urinary catheter drainage system which demonstrates how a dependent loop in the drainage tubing will result in a trapped air volume on the patient side of the loop. The meniscus height differential will act as a U-tube manometer in this scenario and provide an accurate measure of pressure in the trapped air space and thus back pressure into the patient's bladder.