

Urine Drainage Tubing Configuration Affects Urinary System Outflow Pressure in an In Vitro Model

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Background: A dependent loop is a commonly observed configuration in urine drainage tubing. Loops are associated with CAUTI [1] and can generate pressures large enough to obstruct flow in urine drainage systems [2]. An in vitro investigation of the pressures required to move urine through a Foley catheter, urine drainage tubing, and into a vented collection bag was undertaken. We hypothesized that dependent loops in urine drainage systems can generate back-pressure on the bladder that interferes with bladder emptying.

Methods: An in-vitro model (Figure 1) consisting of an infusion pump (Alaris PC 8015 Series, CareFusion, San Diego CA) to mimic urine production, a modified 500 ml IV bag (Baxter, Deerfield IL) to model the bladder, and a Foley catheter and urine drainage system (drainage tubing and vented collection bag, Bard Medical Division, Covington, GA) were assembled. We measured and recorded pressures in the "bladder," at the urine culture port, and in the collection bag via electronic pressure sensors. We varied the dependent loop depth based on dimensions observed in our operating rooms.

Results: Bladder pressures in excess of 30 mm Hg that need to be overcome to move urine through a urine drainage system can result from drainage tubing loops. Peak bladder pressures (Figure 2) are directly related ($R^2=0.998$) to the difference of elevations of the distal and proximal menisci.

Conclusion: Dependent loops should be avoided in urine drainage tubing to reduce the possibility of applying back-pressure to the bladder. Collection of urine in the dependent loop and an ensuing difference in meniscus elevation indicates the development of back-pressure where the back-pressure in $\text{cm H}_2\text{O}$ is directly related to the elevation difference between distal and proximal urine menisci in the drainage tubing.

References: [1] Emerg Infect Dis 7:342-347, 2001. [2] J Urol 177:203-207, 2007.

Figure 1



Figure 1: In vitro model of urinary system, Foley catheter, drainage tube and collection bag

Figure 2

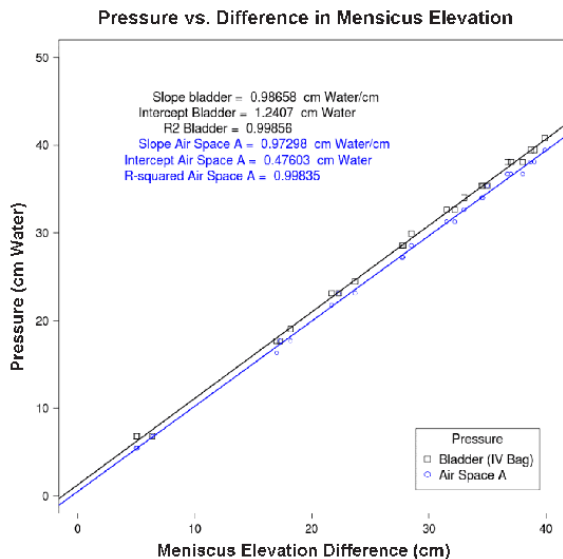


Figure 2: Bladder and air space pressures vs. meniscus height difference