

# Comparing the Efficiency of Tumescence Infiltration Techniques in Burn Surgery

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## Problem

- Nearly 500,000 patients per year are treated for burn injuries in the United States, requiring lengthy, multistep operations in their care. Previous quality improvement foci in burn care have involved reductions in operating time to improve patient outcomes.
- Acute burn wound care in the operating room is complicated by blood loss, hypothermia, and coagulopathies, all of which are exacerbated by extended operative times.
- Infiltrating tumescent solution with a dilute vasopressor is a frequently performed step prior to tangential excision of deep burns and/or harvesting of donor sites, as to reduce blood loss and improve tissue dissection.
- Tumescence infiltration can be performed via two common methods, either manually or via a pump, and is performed repeatedly during burn surgical cases. Accordingly, evaluation of the efficacy of methods utilized in this step is an appropriate focus for quality improvement in burn care.
- Determining the most optimal technique for this common surgical intervention aligns with the Annual Operating Plan goal for quality and safety, through improving patient outcomes and reducing overall operative times.

## Goal

- This study aims to optimize the efficiency of a frequently used intervention in acute burn care through a comparison of the efficiency of two common methods of tumescent infiltration, the manual technique and via a pump device, in terms of time and economy of motion.

## Strategy

- 14 consecutive adult burn patients at a single center requiring excision and grafting were enrolled into the study and 16 cases were randomized into either manual (N=8) or pump infiltration (N=8).
- Infiltration with epinephrine solution (1:500,000) was performed to the endpoint of tumescence in each case by a single surgeon at UCMC and was filmed and analyzed for duration, number of maneuvers, and volume of tumescence injected.
- The endpoint of tumescence was determined by the surgeon as the minimum volume required to reach tissue tumescence on palpation. Operating room staff was familiar with both methods and the tumescence setup was prepared synchronously in the background prior to the beginning of the operation.
- Patient data was extracted using chart review, and any surgical complications directly resulting from infiltration of the tumescent solution were recorded, to determine the optimal method for infiltration.
- A literature review of methods for tumescence infiltration and current barriers in acute burn wound care was also performed to adequately guide this project.



Left: Pump set up for tumescence infiltration. (A) A set of blunt infiltration annulae are connected to sterile tubing with a (B) peristaltic pump (EZ Pump, Braemar Manufacturing, LLC, Eagan, MN) set at 300 mL/minute to infiltrate tumescent solution.

Right: For the pump method, the following maneuvers were counted as one move each: incision with scalpel, widen incision with mosquito, insert cannula into incision, press foot pedal, unscrew cannula, and screw on new cannula.

## Results

	All Subjects (n=14)
%TBSA – Mean (SD)	16.9 (20.7)
Age – Mean (SD)	41.8 (19.5)
BMI – Mean (SD)	31.1 (7.4)
Mechanism – N (%)	
Flame	9 (64.3)
Scald	2 (14.3)
Contact	3 (21.4)
Area Infiltrated (cm <sup>2</sup> ) – Mean (SD)	667.0 (372.3)
OR Time (mins) – Mean (SD)	182.1 (80.0)

Table 1: Subject Demographics

	Manual	Pump
TBSA (%)	12.2	31.8
Area infiltrated (cm <sup>2</sup> )	464.2	852.9
OR time (mins)	155.5	208.6

Table 2: Demographics by Arm

	Manual	Pump	P
Speed (cm <sup>2</sup> /s)	1.1	2.0	<.001
Maneuvers (cm <sup>2</sup> /move)	1.1	37.8	<.001
Volume (mL/cm <sup>2</sup> )	2.4	1.7	.03

Table 3: Efficiency outcomes for the manual and pump techniques of tumescent infiltration.

## Additional Results:

- There were no significant differences measured for any of the efficiency metrics when comparing the efficiency of tumescence donor sites to eschar (P > .05 for all tests).
- Regression models showed no significant association (P > .05) between the speed, efficiency of maneuvers, or volume infiltrated and TBSA, BMI, age, surgical time, or anatomic location of the site being infiltrated.
- There were no reported surgical complications associated with the infiltration of tumescence in either group.

## Conclusions

- From the efficiency outcome, using a pump to infiltrate tumescent solution prior to excision and grafting in the burn patient may reduce operative time and surgeon fatigue by increasing speed and improving economy of motion.
- These findings have implications on the improvement of care for patients in terms of reducing complications related to lengthier operating times, as well as optimizing a surgeon's economy of motion.
- Further studies should seek to replicate these findings in larger cohorts and further investigate the difference in volume of tumescent fluid required to reach tumescence with each technique.

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Left: Manual setup for tumescence infiltration. An 18-gauge spinal needle on a 10 mL aspirating syringe is connected to sterile tubing via a three-way stopcock to infiltrate tumescent solution. Right: For the manual method, the following maneuvers were counted as one move each: insert needle into skin, push syringe, turn stopcock, and fills syringe.