Comparison of a Peristaltic Suction Pump to Wall Suction Regulator as an Airway Clearance Device

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BACKGROUND

Airway suctioning is an essential procedure aimed at preserving airway patency and minimizing mucus accumulation in the lungs and artificial airway. Adverse consequences, such as hypoxemia, reduced lung volume, diminished lung compliance, and harm to airway tissues, can result from the application of negative suction pressures. The primary factors contributing to these complications include the suction pressure setting, the ratio of the suction catheter (SC) to the endotracheal tube (ETT), the duration of the suctioning procedure, and the volume of air extracted. Attempts to minimize these complications are necessary to patient safety. The goal of this project was to compare a low-flow suction device (EXSALTA) to wall suction. The research questions (RQ) are 1: Does the EXSALTA reduce the amount of flow withdrawn compared to wall suction? 2: Does the EXSALTA generate less negative pressure compared to wall suction? 3: Does the EXSALTA remove an equivalent amount of mucus from the ETT compared to wall suction?

METHODS

Testing included ETTs from 2.0mm to 8.0mm and SCs from 4Fr to 14Fr. SC:ETT ratio and suction pressure was matched based on the AARC CPG recommendations. During all testing, negative pressure was applied for 8-9 seconds and during withdrawal only. During all testing events, the SC was inserted to the tip of the ETT with suction applied as the SC was withdrawn. For RQ1, differences in flow were assessed using a TSI 5000 flow sensing device attached to the distal end of an airway model. For RQ2, distal pressure was assessed with a digital manometer and a gauge manometer. The manometers were placed distal to the lung model and ETT. For RQ3, sputum removal was assessed using artificial sputum. Each ETT was filled with sputum and subjected to a suction procedure. ETTs were weighed using a digital scale before and after suctioning. A p-value of .05 was used to determine statistical significance.

Table 1: Average flowrate generated by wall suction and EXSALTA suction in an airway model.

Mean Flowrate-Wall (LPM)	9.41
Mean Flowrate-EXSALTA (LPM)	1.05
Statistically significant difference in mean flowrate scores; p<0.001	

Figure 1: Flowrate comparison between wall and EXSALTA during suctioning in an airway model with a 3.0mm ETT.

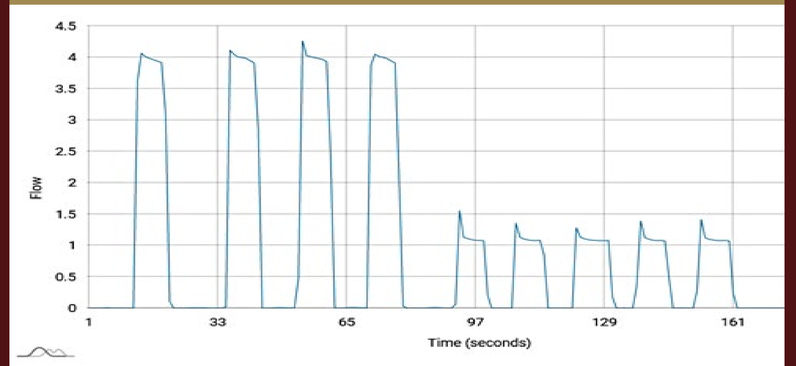

Table 2: Average peak negative pressure by wall and EXSALTA during a suction maneuver

Negative Pressure-Wall (mean, cmH2O)	-48.56
Negative Pressure-EXSALTA (mean, cmH2O)	-12.67
Statistically significant difference in mean flowrate scores; p<0.001	

Table 3: Average ETT weight after suctioning sputum from an ETT.

ETT (mm)	Suction Catheter (FR)	Suction Pressure (mmHg)	Weight of ETT with mucus (g)	Weight after wall suction (g)	Weight after EXSALTA suction (g)
2.0	4	-80	4.91	4.82	4.80
2.5	5	-80	5.03	4.91	4.91
3.0	6	-100	7.64	7.37	7.48
3.5	7	-100	8.57	8.14	8.22
4.0	8	-100	10.35	9.92	10.07
4.5	8	-100	11.85	11.16	11.44
No statistically significant difference in mean ETT weights for wall vs EXSALTA suction; p=0.075					

DISCLOSURES: DRW Medical provide an EXSALTA, suction catheters, ETTs, and simulated mucus to conduct this study. DRW Medical provided no other assistance for this study. The first author has received compensation by DRW for unrelated statistics analysis. The authors have no other financial disclosures to report.

RESULTS

Paired samples T-test was used for all analysis. For RQ1, the EXSALTA generated lower suction flowrates. The differences in flowrate were statistically significant (p<.001). For RQ2, the EXSALTA generated lower peak and sustained pressures during suctioning. Both differences in pressure were statistically significant (p<.001). For RQ3, when evaluating ETTs 2.0mm to 4.5mm, there was no statistically significant difference in the weight of the ETTs for wall suction vs EXSALTA suction (p=.075). When evaluating ETTs 5.0 mm to 8.0mm, there was a statistically significant difference in weight of the ETTs for wall suction vs EXSALTA suction. (Mean weight: 19.03g vs 19.50g; p<.001).

CONCLUSIONS

The peristaltic pump was able to generate a lower negative pressure in the distal airway and lower flowrate extraction, while suctioning an equivalent amount of sputum when compared to wall vacuum. These results are most notable for infant ETTs. Our findings could reduce complications associated with suctioning a patient's airway. Additional testing on human or animal subjects is needed to further evaluate the effectiveness of the EXSALTA device.

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