

Project #10

TEP Insufflator

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Today's Agenda

- ❖ Project Overview
- ❖ Brief Over of Papers
- ❖ Definitions
- ❖ Discussion
- ❖ Findings
- ❖ Relevance
- ❖ Questions

Project Overview

Project Overview

Paper

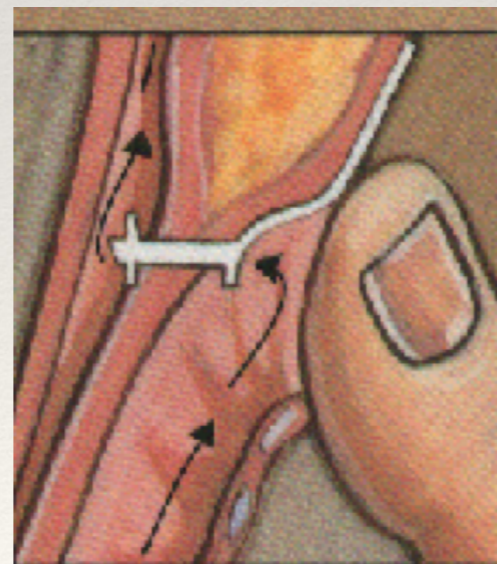
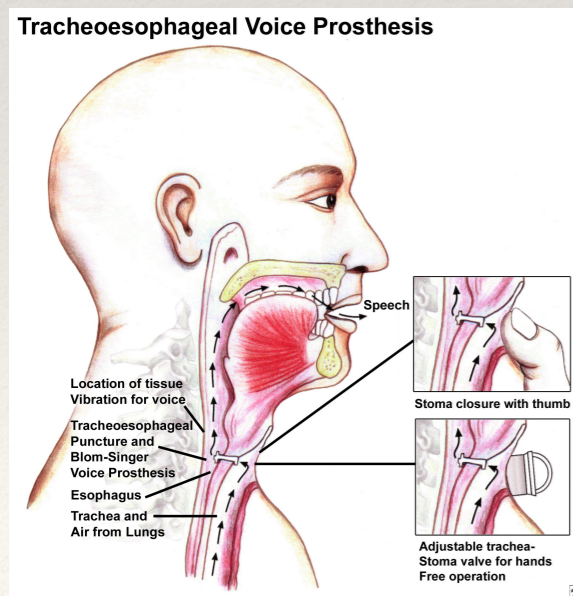
Definitions

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Relevance

- ❖ Goal: to develop a device that would enable tracheostomy patients to breathe / speak easier
- ❖ Specifically, we aim to eliminate the need for the patient to cover his / her stoma with their thumb to speak for reasons mentioned earlier



Device of Interest

Project Overview

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- ❖ Goal is to use a CPAP device to deliver continuous air to the stoma
 - ❖ *Stoma is the opening in the neck as seen before*
- ❖ Specifically:
 - ❖ We want to deliver an insufflator so that the patient may speak hands free
 - ❖ Allow the patient to have a single on/off to speak and breathe without effort

Paper

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- ❖ Kanter, R. K., Pollack, M. M., Wright, W. W., & Grundfast, K. M. (1982, July). Treatment of severe **tracheobronchomalacia** with continuous positive airway pressure (CPAP). *Anesthesiology*. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/7046516>
- ❖ This paper is quite old; however, holds true to today's times
- ❖ Novel idea —> no current research fully relevant

Tracheobronchomalacia

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- ❖ “Tracheomalacia (TM) is a rare condition where the trachea is weak due to soft cartilage in a certain area or throughout the trachea. If the mainstem bronchi are involved as well, the term tracheobronchomalacia (TBM) is used”
- ❖ From the National Center for Advancing Translational Sciences

Discussion

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- ❖ Paper focuses on apnea in an infant
- ❖ Specifically:
 - ❖ Infant developed respiratory distress at 5 days of age
 - ❖ This called for an emergency tracheostomy
 - ❖ *Tracheostomy is the removal of the trachea (voice box)*
 - ❖ To treat the infant, surgeons used a CPAP device for better air flow

Findings

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- ❖ Although patient was an infant, similar findings are found in adults
- ❖ Surgeons tested the use of a CPAP with a maximum pressure of 8 cmH₂O
- ❖ Pressure was ample to help the infant but results could have been improved
- ❖ Thus, surgeons tested a higher pressure of 14 cmH₂O

Additional Findings

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- ❖ Paper concludes that CPAP:
 - ❖ Eliminates need for muscle relaxants
 - ❖ Generally necessary as walls of stoma (cartilage) elongate with overuse
 - ❖ Eliminates mechanical ventilation
 - ❖ Reduces maintenance

... The Results (Continued)

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TABLE 1. Transpulmonary Pressure Change [P_{tp} (I-E)], Peak Flow Rate (PFR), Tidal Volume (TV), Respiratory Rate (RR), Minute Ventilation (VE), and End-tidal P_{CO_2} (P_{ETCO_2}) at Varying Levels of Continuous Positive Airway Pressure (CPAP)

CPAP (cmH ₂ O)	P_{tp} (I-E)*	PFR (I/E)†	TV (ml)	RR (breaths/min)	\dot{V}_E (ml/min)	P_{ETCO_2} (mmHg)	Comment
0	10-16.5	25-35/20-25	8-10	36	300	78	Agitated, distressed
8	2-9.5	30-70/15-50	10-38	54	832	68-76	Agitated, distressed
14	8-9.5	60-90/50-75	20-25	60	1267	49	2 min after CPAP changed to 14 cmH ₂ O, calm
14	1-2	50-60/50-70	25-38	45	1298	49	7 min after CPAP changed to 14 cmH ₂ O, calm

* P_{tp} (I-E) = change in transpulmonary pressure from inspiration to expiration where transpulmonary pressure = measured airway pres-

sure minus measured esophageal pressure (in cmH₂O).

† PFR (I/E) = Peak flow rate inspiratory/expiratory (in ml/s).

... The Result

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- ❖ 14 cmH₂O is high for an infant
- ❖ Following findings were noticed:
 - ❖ Relieved distress
 - ❖ Increased flow rates
 - ❖ Reduced work in breathing

... The Results (Continued)

Project Overview

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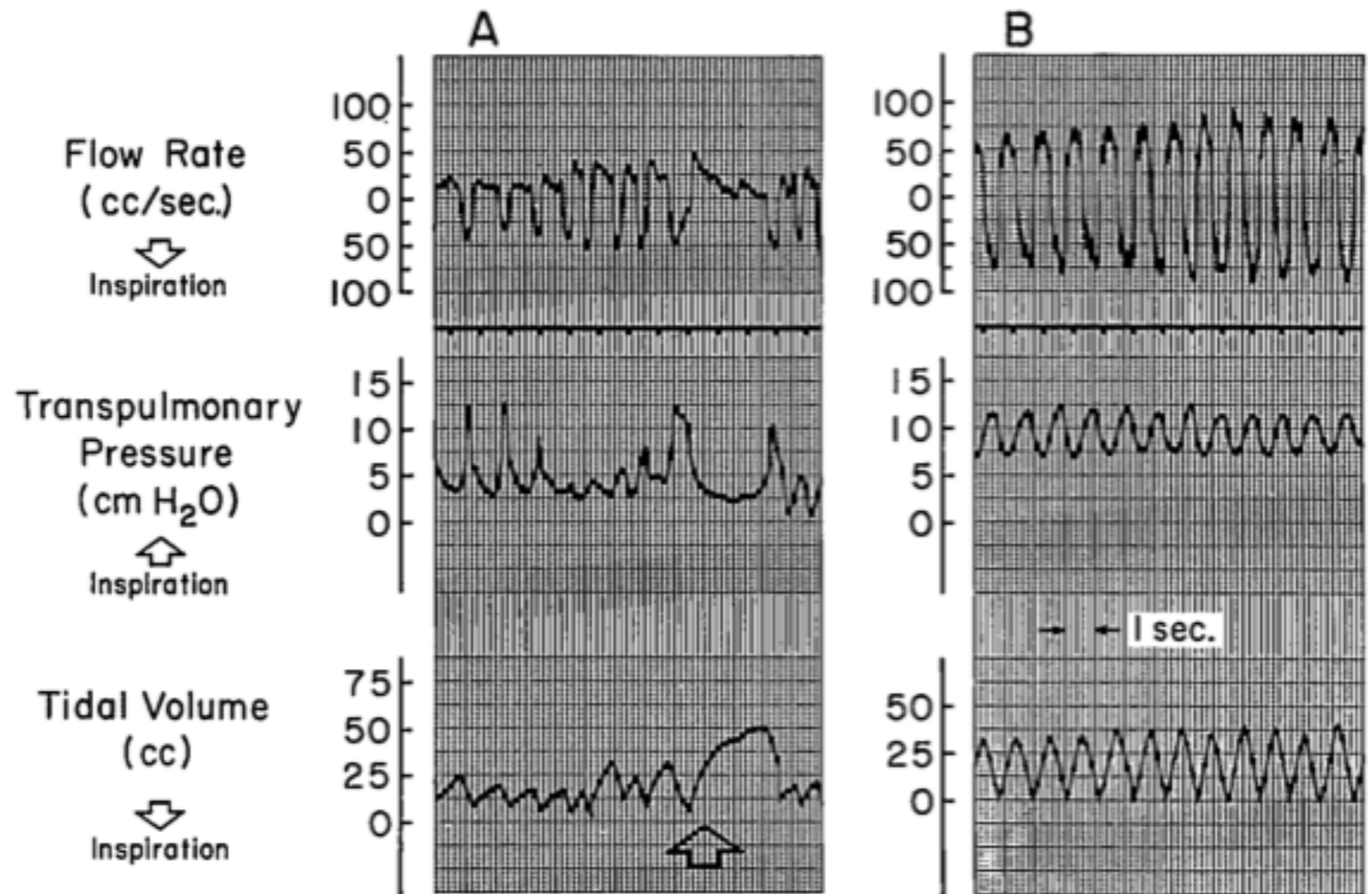
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FIG. 1. Tracings demonstrate air flow in ml/s (*top*), transpulmonary pressure in cmH₂O (*middle*), and tidal volume in ml (*bottom*). (A) Shows patient with distressed breathing on CPAP = 8 cmH₂O. Note wide swings of transpulmonary pressure between inspiration and expiration with low tidal volume and air flow despite labored effort. Also note prolonged forced expiratory phase (*arrow*). (B) Recording 5 min later on CPAP = 14 cmH₂O with improved tidal volume and air flow and smaller swings of transpulmonary pressure.



Transpulmonary pressure: difference between alveolar and intrapleural pressure in lung

Relevance

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- ❖ TEP Insufflator's goal is to cover the stoma and eliminate unnecessary work through a CPAP
- ❖ Kanter et al.'s study proves that a CPAP with 14 cmH₂O works in infants
- ❖ Using this knowledge (and increasing pressure to 30 cmH₂O), we can replicate similar benefits (plus goals of this project) in children and adults

Relevance

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TEP Insufflator Goals Kanter et al. Findings

Relieve distress

Relieved distress

Increase mobility
without compromise

Increased flow rates

Reduce effort involved
in management

Reduced work in
breathing

Questions?

