Iatrogenic Consequences of Airway Suction can be Devastating

Objectives: 1) Identify iatrogenic consequences of nasal, oral, and tracheotomy airway suction
2) Name factors to consider when performing airway suction
3) Cite the research base and proper technique for shallow-technique suction

Methods: An extensive review of research on suctioning was conducted; 300 articles were read. Current practice, determination of need, base procedure (duration, frequency, depth, negative pressure, catheter design and size), adjuncts (saline, hyperinflation, hyperventilation, and hyperoxia), and suctioning times were factors searched. References were studied for additional sources. Pivotal research spans sixty years, and key points presented here. Pediatric otolaryngology and pulmonology assisted with the review.

Conclusions: Frequent and deep until-resistance-is-met suctioning causes great harm. Complications include: atelectasis, hypoxia, hypoxemia, pneumonia, tracheobronchial ulceration, granuloma, infection, altered lung compliance, and massive atelectasis. Increased negative cardiovascular changes, increased intrapulmonary pressure, and death. A proposed shallow technique is hypothesized to prevent these complications. A limitation is that few research studies identify complete suction technique or control its variables and adjuncts.

Increased Intrapulmonary Pressure

• Deep suctioning was found to increase intrapulmonary pressure.
  • Suctioning caused a systemic hypotensive response that was cumulative with additional passes
  • Nauck et al., 1981: In 7 newborn lambs under normoxic deep suction conditions, mean arterial pressure increased 11% under hypoxic conditions. The increase was 27% with ventilator-controlled technique and 32% with resuscitative bag-controlled technique.
  • Parkman & Volpe, 1983: In a randomly selected inducted NICU infants weighing less than 2.0 kg/m2, with deep suctioning, mean arterial pressure increased an average of 1.3 ± 0.7 mm Hg from a baseline of 5.3 ± 3.0 mm Hg. Authors suggested prospective study to evaluate relationship of suction with intravascular hemodynamics.

Negative Cardiovascular Changes

• Bradycardia, hypoxia, arrhythmias, and EKG changes suggestive of endocardial ischemia
  • Vagal response; Prolonged ventilation (forced aspera)
  • Cofit et al., 1994: In ventilated premature infants, bradycardia occurred in all suctioning events. Four infants had nodal rhythm bradycardia (HR < 70) that normalized with shallow suctioning. More impressively, no changes in heart rate occurred with vagotomy. More impressively, no changes in heart rate occurred with vagotomy. More impressively, no changes in heart rate occurred with vagotomy. More impressively, no changes in heart rate occurred with vagotomy.
  • Sims et al., 1990: In a random study of newborn infants: both partially-ventilated and non-ventilated endotracheal suction caused abrupt bradycardia and hypoxic events. Authors specified due to vagal pathways, independent of oxygenation.

• Hyperinflation
  • Steady increase in intrapulmonary pressure with each suctioning event.
  • Davis et al., 1991: Studied 18-22 kg. pigs: determined that a circumferential band of negative pressure during suction causes hyperinflation.
  • Hanley et al., 1994: Tidal volume versus suction in ventilated pigs showed hyperinflation with suction. Tidal volume and hyperinflation increased with suction.
  • Segar et al, 1993: In ventilated premature infants, bradycardia occurred in all suctioning events. Mean ventilator disconnected for suction was 22-90 seconds. Associated with decreased oxygenation, increased airway resistance, and decreased lung compliance. Deep suctioning in ventilated infants is proposed. Shallow technique is defined as limiting negative suction to one at a time.

Saline Installation: not a routine, only prn—research needed

• Main benefit may be cough stimulation, but doesn’t always
  • May not displace beyond mainstem bronchi, thin secretions, or increase aspirtate
  • In an in-vitro study suggests possibility for bacterial inoculation.

Not much data exists to support saline instillation and its effects on basic airway physiology:

Hyperoxegenation

• Potential for barotrauma or oxygen toxicity
  • Preoxygenation can raise PaO2 to hyperoxic levels
  • Hypoventilation post-suction can reverse atelectasis
  • Hyperoxegenation or manometric monitoring can prevent ventilation-induced injury

Preliminary Research Based Shallow-Technique Suction

Discussion: Most studies used a deep technique. Deep technique causes abundant paradoxical mucus production and more. Shallow technique would eliminate complications caused by deep technique. A shallow catheter and suction system ratio would eliminate atelectasis and allow influx of air and prevent hypoxia. Mucociliary action would clear natural airways of mucus.

Applying suction in an artificial airway would replace mucus without disturbing ventilation. Natural cough is preferred.

Shallow-Technique Suction: A preliminary research-based protocol for shallow-technique suctioning in pediatric patients is proposed. Shallow technique is defined as limiting catheter insertion to no further than 0.5 cm beyond the distal end of an artificial airway. In the premature infant, limit insertion to the distal end of an artificial airway. Use a catheter with an external diameter less than 1.7 mm. Natural cough is preferred. Eliminate routine use of saline. Decrease duration of a single suction pass to 5 seconds. Apply suction both on insertion and withdrawal while moving the catheter in a rotating motion. Only suction when necessary, not as a routine. Controlled research needed.