

Introduction

- An intact pilot balloon is crucial to proper function of a cuffed endotracheal tube (ETT).
- Failure of the pilot balloon or disruption of the inflation tubing results in cuff deflation which may lead to inadequate ventilation and aspiration of oropharyngeal secretions.
- We describe a method that we employed using readily available components to repair a pilot balloon and inflation tubing, and report on the effectiveness of the repair method, as tested in vitro.

Methods

- Repair Method (Fig. 1)
 - A 22 g IV catheter with the hub cut off was inserted into the severed end of the inflation tubing and cut just distal to the end of the catheter.
 - A new pilot balloon assembly was cut off from an intact ETT and guided over the catheter, with the catheter serving as a stent.
 - A ¼" Steri-Strip™ (3M™; MN, USA) was wrapped around the repaired segment to mitigate against separation of the stented tubing.
- ETT cuff pressure drop measured over 8 hours in an artificial tracheal model (20 cm syringe) of 10 intact and 10 repaired ETTs from an initial inflation pressure of 20-30 cm H₂O.
- Cuff pressures measured with a Cufflator (Posey, CA, USA), adjusted for the small loss of pressure from the measurement itself.
- Integrity of 10 repaired segments tested to high-pressure inflation by placing the repaired segment under water and looking for air bubbles.
- Static tensile strength of the inflation tubing tested from 7 intact and 7 repaired ETTs.
- Data are presented as the mean ± standard deviation. Differences were assessed using the unpaired, 2-sided Student t-test, with P<0.05 required for statistical significance.

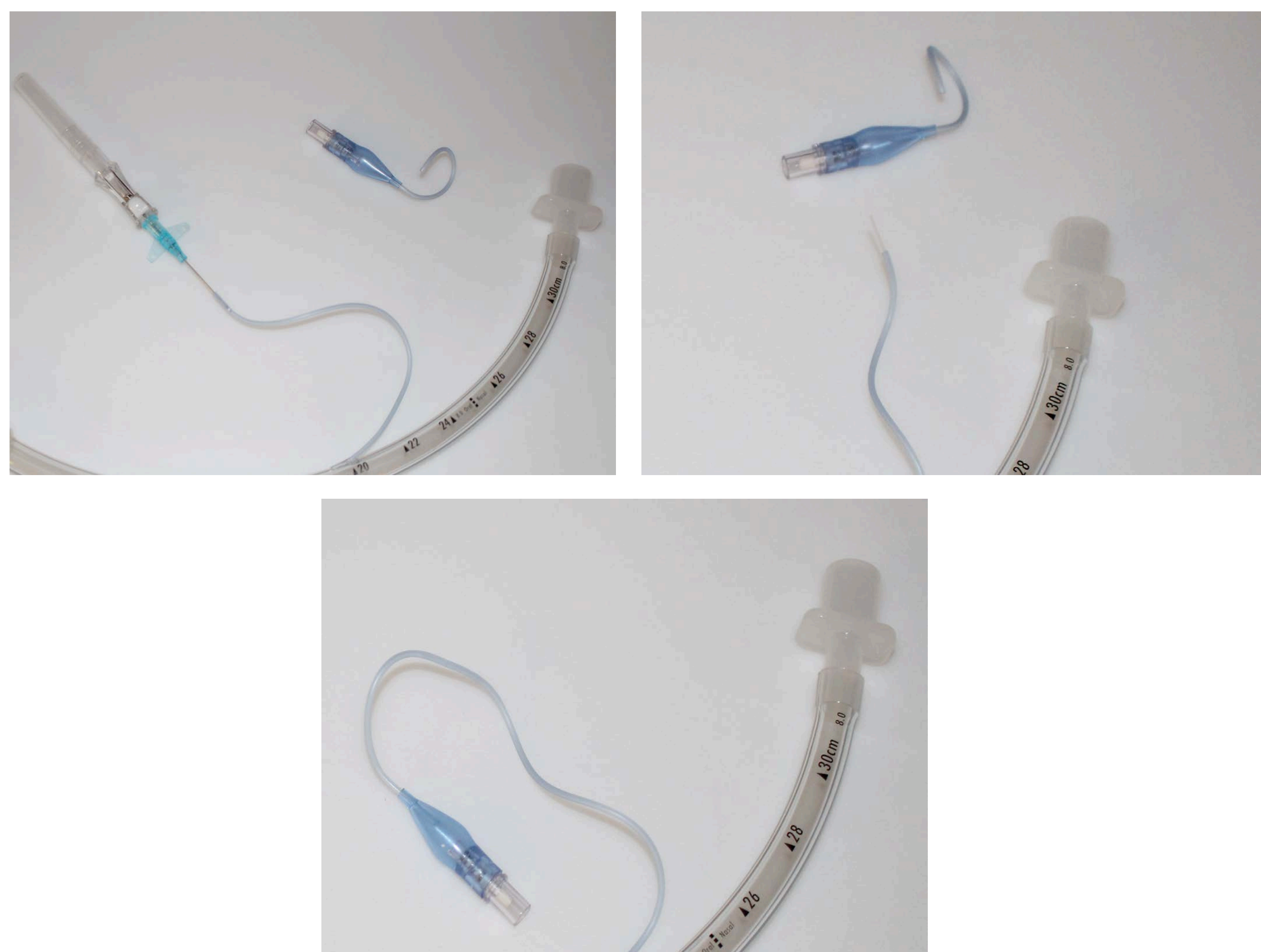


Figure 1. ETT repair method

References

1. Kovatsis, Pete G., John E. Fiadjoe, and Paul A. Stricker. "Simple, Reliable Replacement of Pilot Balloons for a Variety of Clinical Situations." *Pediatric Anesthesia* 20, no. 6 (June 1, 2010): 490-94.
2. Singh, Manpreet, Ritu Bharti, and Dheeraj Kapoor. "Repair of Damaged Supraglottic Airway Devices: A Novel Method." *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 18, no. 1 (June 17, 2010): 33.
3. Yoon, Kyung-Bong, Byung-Ho Choi, Hye-Sook Chang, and Hyun-Kyo Lim. "Management of Detachment of Pilot Balloon during Intraoral Repositioning of the Submental Endotracheal Tube." *Yonsei Medical Journal* 45, no. 4 (August 31, 2004): 748-50.

Results

- Eight-hour interval measurements in 10 intact vs. 10 repaired ETTs demonstrated a difference in the mean pressure drop of 0.5 cm H₂O (95% CI -2.2 to 1.2 cm H₂O, P = 0.54) (Fig. 2).
- No visible air leak from the repaired inflation tubing segments when cuff inflated to 120 mm Hg.
- Tensile strength testing revealed that the mean force needed to break intact inflation tubing was 36.4 ± 2.7 N (N=7).
 - Repaired inflation tubing was only able to withstand a mean force of 14.5 ± 3.7 N (N=7) before disruption (mean difference =21.9 N, 95% CI 18.1 to 25.7 N, P < 10⁻⁶) (Fig. 3).
- Repairs using ETTs ranging in size from 3.0 to 8.0 and various manufacturers were successful; in some cases, a 24g IV catheter was required as the stent.

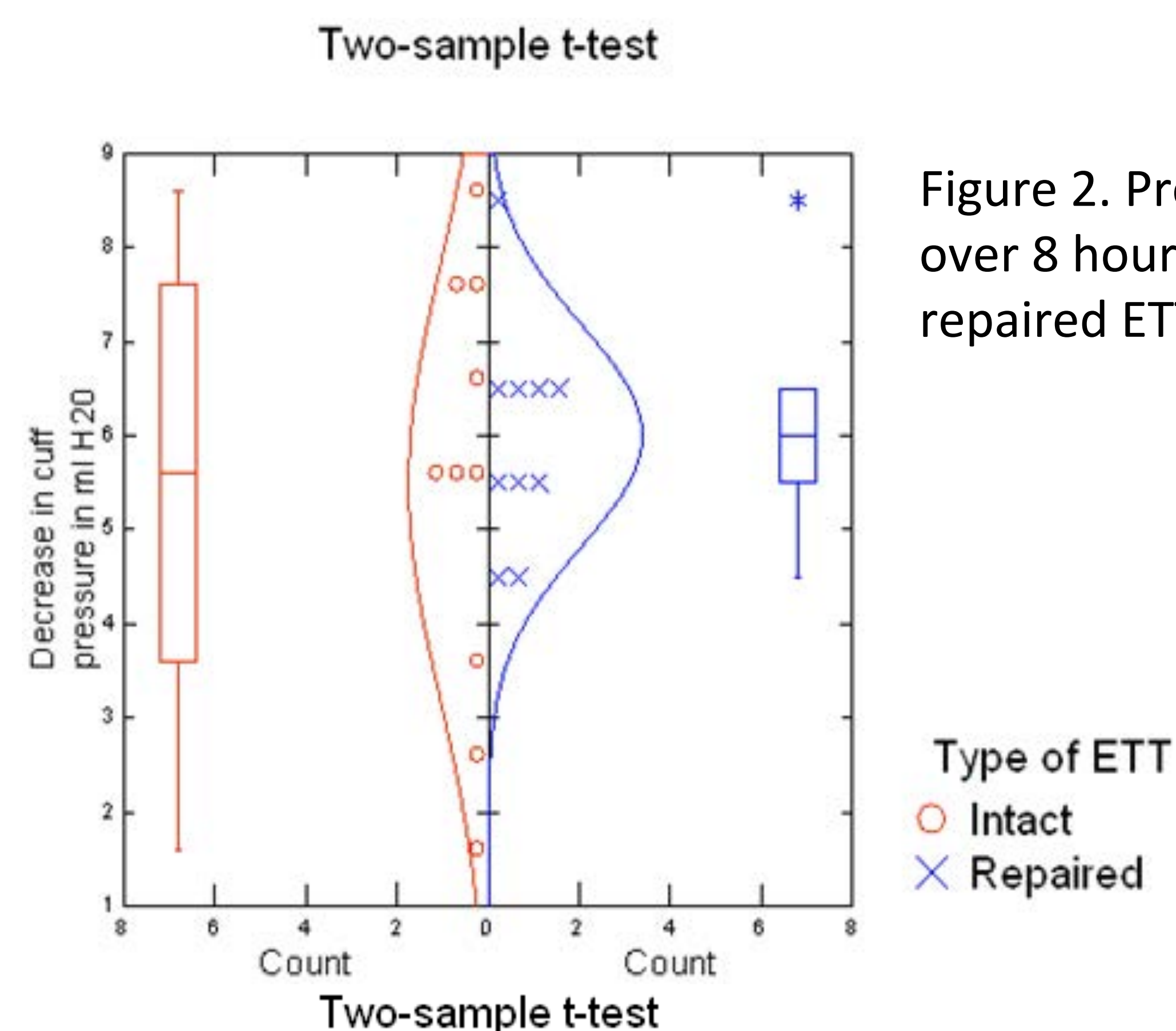


Figure 2. Pressure drop over 8 hours - intact vs. repaired ETT

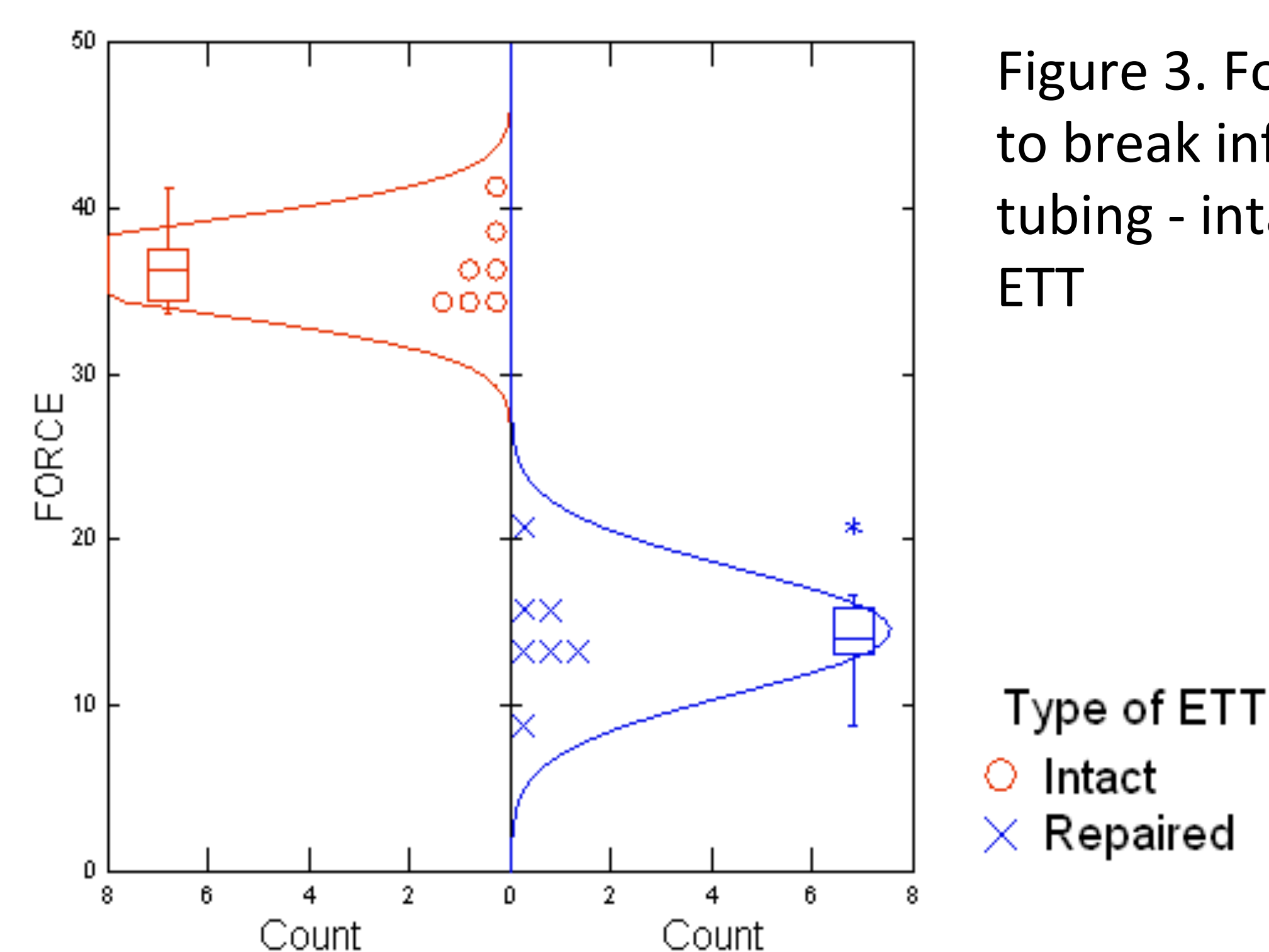


Figure 3. Force required to break inflation tubing - intact vs. repaired ETT

Conclusions

- Our ETT repair method allows for quick, reliable repair of the pilot balloon using readily available supplies.
- A commercial product, BE 409 Pilot Tube Repair Kit (Instrumentation Industries Inc.; PA, USA) is available, using a metal tapered needle as the stent. However, the assembly is not MRI compatible and is not widely available.
- Our described method can be effectively used as a temporizing measure in a situation where ETT exchange is difficult or poses patient risk.
- Due to the reduced tensile strength of the repaired segment, we recommend identifying the repaired tubing with a marker, such as colored tape, in order to alert practitioners.