

An Automatic Cuff Pressure Controller (SmartCuff) Detected Cuff Damage in a Tracheal Tube: A Case Report

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We herein report a case in which an automatic cuff pressure controller (SmartCuff, Murata Manufacturing Co, Ltd) enabled detection of endotracheal tube (ETT) cuff damage. A 23-year-old woman underwent nasally intubated general anesthesia, and several minutes after securing the airway, the device alarm suddenly sounded in response to a drop in cuff pressure. This alerted us to the damaged cuff despite the noted absence of decreased ventilatory volumes or abnormal capnographic waveforms. The damaged ETT was successfully exchanged, and the case proceeded without any further incidents. This case report suggests that an automatic cuff pressure controller is a useful device for monitoring and automatically adjusting cuff pressures throughout an intubated general anesthetic.

CASE PRESENTATION

A 23-year-old woman (height, 156 cm; body weight, 56 kg; body mass index, 23 kg/m²) with skeletal mandibular prognathism underwent maxillary and sagittal split ramus osteotomies under nasally intubated general anesthesia. The patient was induced with intravenous (IV) target-controlled infusion of propofol (5.0 µg/mL) followed by an IV bolus of rocuronium (40 mg). A cuffed, size 7.0 Parker preformed nasal

endotracheal tube (ETT; Japan Medicalnext Co, Ltd) was advanced into the right nasal cavity, and while passing the ETT through the nasal cavity, some resistance was felt, resulting in some difficulty manipulating the tube during insertion. Therefore, Magill forceps were used to help pass the ETT through the vocal cords after which 4 mL of air was injected into the ETT cuff and the absence of leakage was confirmed. An adequate tidal volume (415 mL) was obtained using volume-controlled ventilation (setting value, 425 mL).

The pilot balloon of the ETT cuff was connected to the SmartCuff (Murata Manufacturing Co, Ltd; Figure 1A) automated cuff pressure controller device, and when the cuff pressure was set at 28 cmH₂O, the SmartCuff alarm began to sound. Because the cuff pressure was lower than 21 cmH₂O despite the absence of a decreased ventilation volume or an abnormal capnographic waveform, we suspected that a poor cuff seal had occurred secondary to cuff damage during intubation. Thus, the nasal ETT was immediately exchanged for another one (same design but size 6.5) without any difficulty. The surgical operation was successfully completed without any additional respiratory issues or other complications. Upon examination of the damaged ETT, we found a small (1 mm) hole along the surface of the cuff (Figure 2).

DISCUSSION

The SmartCuff is a useful device that automatically monitors and maintains the ETT cuff pressure within a set range (5–80 cmH₂O; Figure 1B) by measuring the air pressure of the connected ETT pilot balloon. An alarm sounds when a low cuff pressure is sensed (Figure 1C). Continuous control is

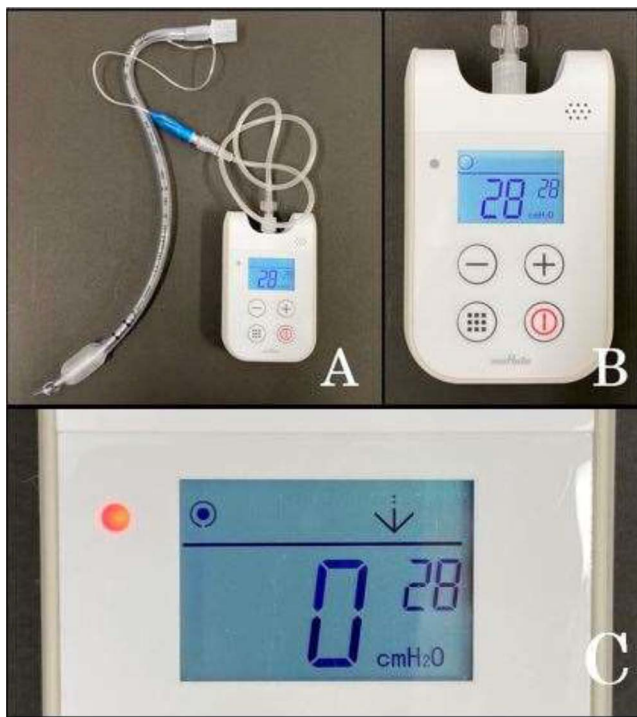
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Figure 1. SmartCuff Connected to the Valve of the ETT Pilot Balloon.



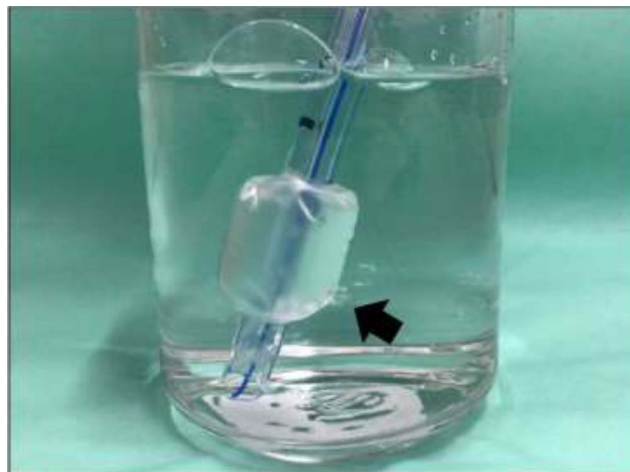
(A) The SmartCuff device automatically controls the internal cuff pressure once connected to the ETT pilot balloon valve. An extension tube is used to attach the SmartCuff device to the pilot balloon. (B) Enlarged view of the SmartCuff device showing the set (upper right) and measured (center) cuff pressure values. (C) A decrease in cuff pressure is indicated by the red alarm light on the front of the instrument screen and the downward-pointing arrow. The black dot indicates that the equipment is operating correctly. The numbers “28” and “0” on the screen show the set values and the currently measured values, respectively. ETT, endotracheal tube.

also beneficial in preventing excessive increases in the ETT cuff pressure which may interfere with adequate perfusion of the tracheal mucosa, resulting in local tissue damage.¹ Furthermore, automatic control of the cuff pressure can reduce the incidence of excessive cuff pressure decreases (cuff pressures <20 cmH₂O) compared with manual adjustment.²

In the present case, we suspected that the cuff had been damaged when the ETT tip was grasped with the McGill forceps during nasal intubation. However, a rapid decrease in cuff pressure secondary to cuff damage did not occur because the cuff damage only involved the presence of a small hole that was apparently blocked by the tracheal mucosa upon inflation of the cuff.

To manually check the cuff pressure during the operation, the surgical procedure is often disrupted while the pressure

Figure 2. The Damaged ETT Cuff.



Air bubbles (black arrow) leaking from the small hole on the damaged ETT cuff were observed when air was injected into the cuff via the pilot balloon valve. ETT, endotracheal tube.

gauge is used. The SmartCuff device does not create the same type of disruptions. Additionally, the measured data obtained with manual pressure gauges are intermittent values, not continuous values. Thus, it can be difficult to determine the exact time point at which the cuff pressure changes when using a manual device as compared with the automated SmartCuff device.

CONCLUSION

We experienced a case in which a SmartCuff automated cuff pressure controller device enabled prompt detection of ETT cuff damage. The SmartCuff device is useful for not only automatically monitoring and maintaining ETT cuff pressures but also early detection of cuff damage.

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REFERENCES

1. Nseir S, Lorente L, Ferrer M, et al. Continuous control of tracheal cuff pressure for VAP prevention: a collaborative meta-analysis of individual participant data. *Ann Intensive Care*. 2015;5:43.
2. Dauvergne JE, Geffray AL, Asehnoune K, Rozec B, Lakhil K. Automatic regulation of the endotracheal tube cuff pressure with a portable elastomeric device. A randomized controlled study. *Anaesth Crit Care Pain Med*. 2020;39:435–441.