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Research article

Unplanned extubations in an intensive care unit: Findings from a critical incident technique

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ABSTRACT

Background: Patients on mechanical ventilation are at risk of experiencing a potentially life-threatening unplanned extubation in the intensive care unit, which can lead to arrhythmias, bronchial aspiration, difficulty in reintubation or even sudden cardiac arrest. Although incidence and outcomes of the phenomenon have been documented in several quantitative studies, no studies have investigated the antecedents as experienced by critical care nurses.
Objectives: To gain a greater understanding of the antecedents of unplanned extubations.
Methods: A qualitative study design involving the critical-incident technique. A total of 10 registered nurses who reported one or more episodes of unplanned extubations were involved in an in-depth interview.
Findings: According to the nurses' experience, episodes of unplanned extubations are determined by predisposing, precipitating and mediating factors. The predisposing factors have been recognised in the (a) weaning programme (expected/unexpected decreased sedation) and in the (b) patient factors (increased needs due to discomfort, restlessness and desire to communicate). The precipitating factors have been divided into (a) organisational (failures in multi-professional communication), (b) environmental (excessive environmental chaos and barriers preventing direct surveillance) and (c) nursing care factors (ensuring privacy by creating barriers, avoiding disturbing other patients and poor nurse-to-patient ratio). Among the mediating factors, which are affected by the precipitating factors, decreased surveillance and mechanical restraints' use have been identified.
Conclusion: Identifying risk factors of unplanned extubation, specifically those that are modifiable, such as increasing interprofessional communication, reducing excessive environment chaos, implementing strategies aimed at overcoming barriers threatening direct surveillance and ensuring appropriate nurse-to-patient ratio, can prevent the occurrence of these events.

Implications for clinical practice

- Strategies to prevent unplanned extubations can be achieved firstly by identifying patients at risk and then educating nurses about the multifaced factors that cause the phenomenon.
- Implementing standardised protocols for weaning and adopting communication support programmes should be promoted in order to improve the quality of care and to ensure patients' comfort.
- In addition, promoting a comfortable environment and increasing nurses' direct surveillance need to be encouraged as important strategies to endorse patients' safety.
- Further research is recommended to develop more knowledge on the phenomenon of unplanned extubations, aiming at validating the emerged factors across ICUs and countries, as well as establishing quantitatively the contribution of each factor that has emerged.

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Introduction

Endotracheal intubation has been documented as the most commonly performed procedure among intensive care unit (ICU) patients, aiming at delivering effective mechanical ventilation. Despite being an essential life-saving intervention, the endotracheal intubation has been reported to increase the risk of some adverse events and/or complications such as severe hypoxaemia, hypotension, oesophageal intubation and aspiration (Divatia et al., 2011). The weaning process from mechanical ventilation and the removal of the endotracheal tube are both considered decision-making processes and interventions under the responsibility of the medical team. When all weaning criteria are fulfilled and the patient is capable of tolerating at least two hours of spontaneous breathing trial through the T-tube without reporting signs of distress, they are ready to be exposed to 'planned extubation' (PE) (Ismaeil et al., 2014). However, the risk of unplanned removal of the endotracheal tube is a source of concern among nurses and physicians (Richmond et al., 2004).

Patients on mechanical ventilation can experience potentially life-threatening unplanned extubation (UE), defined as accidental or patient-induced premature removal of the endotracheal tube (Chao et al., 2017; Richmond et al., 2004). While the first can occur while patients are transported to undergo diagnostic procedures or during some interventions e.g., secretions removal and coughing, deliberate self-extubation occurs when patients under certain situations intentionally remove the endotracheal tube (Ismaeil et al., 2014). While accidental extubations (8.3%) have been reported to occur mostly among patients undergoing basic nursing care e.g. mouth and tube care, mobilisation or transport, deliberate self-extubations have been reported to occur mainly when the nurse is not at the bedside (Yeh et al., 2004).

The incidence rate of UE has been documented ranging from 3.4% to 22.5% (Kwon and Choi, 2017; Yeh et al., 2004) and re-intubation rates from 1.8% to 88% of all UEs (da Silva and Fonseca, 2012). In the majority of cases (91.7%) the UEs are considered a potentially serious accident causing arrhythmias, bronchial aspiration, difficulties in re-intubation or even sudden cardiac arrest (Chao et al., 2017; Kapadia and Epstein, 2001). Furthermore, patients reporting episode(s) of UE have been documented as having an increased mechanical ventilation duration and ICU length of stay (de Lassence et al., 2002).

Antecedents of UEs have been reported at individual, technology, task, environmental and organisational levels involving the whole ICU working system, as summarised in Table 1 (Kwon and Choi, 2017; Kiekkas et al., 2013). Among individual risk factors, a low level of patient sedation, the consequent high level of consciousness, restlessness, pain and delirium have been reported as increasing the risk of UE (Gonzalez, 2017; da Silva and Fonseca, 2012; Kwon and Choi, 2017). Furthermore, some intrinsic risk factors have also been studied (e.g. age, gender and body mass index) but their role is still unclear (Cosentino et al., 2017).

Table 1
Risk factors of unplanned extubation, based on five components of ICU working system described by Kwon and Choi (2017).

System	Risk factors
Individual	Higher incidence of pain, lower sedation levels, higher likelihood of delirium
Technologies	Mode of mechanical ventilation (spontaneous breathing mode)
Tasks	Higher nursing activities scores
Environmental	Duty time (evening and night shifts)
Organisational	Shorter nurse's career

Legend: ICU, intensive care unit.

With regard to the technology, spontaneous breathing mode, pressure support ventilation and continuous airway positive pressure, have been found to increase UE as compared to mechanical breathing assist mode (Kwon and Choi, 2017). Moreover, although literature has not confirmed the superiority of one specific method over another, a weak endotracheal tube fixation has also been documented as a UE risk factor (Cosentino et al., 2017). Furthermore, with regards to nursing care, UEs have been associated with increased nurses' workloads (Kwon and Choi, 2017; Faisy et al., 2016), when the nurse-to-patient ratio is $\geq$1:3 and when nurses have poor clinical experience (Cosentino et al., 2017; Selvan et al., 2014). Finally, UEs have been reported as occurring mainly during evening and night shifts (Kwon and Choi, 2017). Standardised weaning protocols, implying a routine screening of patients can decrease the risk of UE (Lee et al., 2015). However, an in-depth understanding of factors and their mechanism of action in leading an UE has not been well documented to date (Kwon and Choi, 2017; de Groot et al., 2011) and further studies aiming at developing knowledge on UE risk factors have been reported as the prerequisite for improving nursing care quality and patient safety in the ICU (Kiekkas et al., 2013).

UEs have been documented as a marker of the quality of care and patient safety in ICU (Kwon and Choi, 2017; Stalpers et al., 2017) and have been included among other nurse sensitive outcomes (e.g. pressure ulcers, falls and health-care-associated infections, quality of life; Liu et al., 2012; Moorhead et al., 2014; Riera et al., 2016). Thus, continuing to discover the factors underlying UEs is crucial to the aim of designing interventions to reduce the likelihood of their occurrence (Kiekkas et al., 2013). In this light, the general intent of this study was to gain insights into antecedents to UE incidents as experienced by critical care nurses.

Study design

A qualitative approach involving the critical-incident technique (CIT) established by Flaganan in 1954, was used (Schluter et al., 2008) in 2017. The CIT is a well-established method of qualitative research with a flexible set of principles that can be modified and adapted according to the phenomenon under study: the concept of 'critical incident' refers to those certain situations of great relevance to both patients and staff involved. The concept of 'technique' refers to the process of in-depth critical reflection by analysing human behaviours or contextual factors underlying the phenomenon that took place in clinical practice (Butterfield et al., 2005).

Specifically, according to the CIT approach, five steps were followed: 1) identifying the general purpose; 2) planning, 3) collecting, and 4) analysing data; then 5) interpreting and reporting the findings that emerge (Schluter et al., 2008). Moreover, given its qualitative nature, the study has been reported here according to the consolidated criteria for reporting qualitative research (COREQ) (Tong et al., 2007).

Identifying the general purpose

The general purpose of the study was to gain a greater understanding of the antecedents to deliberate unplanned extubation.

Planning and collecting data

Initially, three general ICUs with a total of 28 beds and a 100% rate of occupancy, located in a 900-bed Italian Academic Hospital were approached. Each ICU environment was based on open rooms in a traditional open space; the staff was composed of registered nurses (RNs) and the nurse-to-patient ratio was 1:2.