Research Article

Investigating Inappropriate Enteral Tube Feeding Discontinuations Related to Gastric Residual Volume in Critically Ill Patients: A Retrospective Observational Descriptive Study

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Citation: Aikawa G, Nobushima D, Hiki T, Sakuramoto H, Unoki T. Investigating inappropriate enteral tube feeding discontinuations related to gastric residual volume in critically ill patients: A retrospective observational descriptive study. *International Journal of Critical Care* 2024;18(3)22-33. doi: 10.29173/ijcc129

Published: October 2024

Acknowledgments: We would like to thank Editage (www.editage.com) for the English language editing.

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ABSTRACT

Background: Gastric residual volume (GRV) is measured by nurses in clinical practice as a simple method to assess gastrointestinal intolerance. Nutrition therapy guidelines recommend avoiding enteral tube feeding (ETF) discontinuation if GRV is < 500 mL.

Aim: This study aimed to clarify the status of inappropriate ETF discontinuation related to GRV in critically ill patients.

Methods: Patients who were ventilated for more than 48 hours in the intensive care unit of a university hospital in 2021 were retrospectively surveyed, and data were collected up to 2 weeks after admission. ETF discontinuation data were collected and categorized as planned or unplanned. The reasons for unplanned discontinuation were further categorized into high GRV, symptoms, and conditions. The reasons and the amount of GRV were analyzed descriptively. Inappropriate ETF discontinuation related to GRV was defined as ETF discontinuation for a GRV of < 500 mL.

Results: ETF was discontinued in 10% (270 events / 2,600 orders) of critically ill patients. Unplanned discontinuations accounted for 37% (99/270) of discontinuations, with GRV being the most common reason (43%), followed by nausea and vomiting (8%), and hemodynamic instability (8%).

Conclusions: Thirty-seven percent of ETF discontinuations in critically ill patients were unplanned, and 42% of these were inappropriate ETF discontinuations related to GRV. Research results and guideline recommendations need to be disseminated clearly to make more healthcare providers aware of the GRV criteria for discontinuing ETFs.

Keywords: gastric residual volume, enteral tube feeding, discontinuation, critically ill, intensive care

INTRODUCTION

The gastrointestinal tract is an essential organ responsible for food digestion, absorption, and excretion. Patients admitted to the intensive care unit (ICU) have impaired gastrointestinal motility due to vasoconstrictors, analgesic sedatives, and fluid management, in addition to severe medical conditions such as surgery, trauma, and cardiopulmonary arrest. As a result, 63% of critically ill patients develop some gastrointestinal symptoms, including high gastric residual volume (GRV), indicating gastrointestinal intolerance, occurring in 39% of patients (Montejo, 1999).Nurses in clinical practice measure GRV as a simple method to assess gastrointestinal intolerance. The GRV is the amount of fluid aspirated from the stomach after enteral tube feeding (ETF), consisting of nutrients and secretions. It is measured by syringe aspiration of the gastric contents directly through the gastric tube (Elke, 2015). Currently, nurses report the GRV to the physician as appropriate, and if the GRV is determined to be too high, ETF is discontinued due to gastrointestinal intolerance. The GRV is measured to avoid vomiting, reflux, and aspiration pneumonia due to gastrointestinal intolerance. However, in a systematic review, Yasuda et al. (2021) questioned the reliability and clarity of the evidence supporting the routine use of GRV as an indicator of gastrointestinal intolerance. Therefore, measurements could cause unnecessary ETF discontinuation, reducing nutrient supply and lengthening the time to reach the target ETF amount (Edwards & Metheny, 2000).

Guidelines for nutritional therapy in critically ill patients suggest avoiding ETF discontinuation if GRV is < 500 mL (Kotani et al., 2016; McClave et al., 2016; Reintam Blaser et al., 2017; Singer et al., 2019). In contrast, GRV criteria may be adopted at < 500 mL (Jenkins et al., 2022)This discrepancy could cause inappropriate ETF discontinuation; however, no research has been conducted on this issue.

This study aimed to determine inappropriate ETF discontinuation related to GRV in critically ill patients.

METHODS

Setting

This retrospective observational study investigated ETF discontinuation and GRV. This study was conducted in the ICU of an 800-bed university hospital. The unit is a 12-bed general ICU with 700–800 patients admitted annually. Participants were selected from patients admitted to the ICU between January and December 2021. The exclusion criteria were age < 18

years, required mechanical ventilation < 48 hours, readmission, and without ETF.

At the subject facility, a nurse aspirated the gastric tube using a syringe immediately before performing ETF and measured the GRV (Elke et al., 2015). Measurements were recorded each time. If the ETF was discontinued, the nurse documented the reason. There was a lack of clear protocol for GRV in this ICU, and each individual evaluated GRV based on the literature, customary practices, and rules of thumb.

Data collection

The following data were collected from electronic medical records: sex, age, Acute Physiology and Chronic Health Evaluation (APACHE) II score for illness severity, admission category, disease classification, mechanical ventilation duration, ICU length of stay, ICU mortality, ETF orders, ETF discontinuation and its reasons, and GRV at ETF discontinuation. Patient data were collected until ICU discharge or two weeks after ICU admission.

If ETF was discontinued, one researcher categorized the reason. One researcher divided ETF discontinuations into planned and unplanned discontinuations. Reasons for planned discontinuation were procedures, tests, catheterization, and surgery. Reasons for unplanned discontinuation were high GRV, symptoms, and conditions. If no reason was recorded, it was assumed to be unknown. *Inappropriate ETF discontinuation related to GRV* was defined as ETF discontinuation for GRV < 500 mL only. In other words, ETF was discontinued according to the GRV, and if the GRV was less than 500 mL at that time, ETF discontinuation related to GRV was considered inappropriate.

All data were analyzed descriptively. Categorical data were expressed as numbers and percentages, and continuous data were expressed as medians and interquartile ranges. The sample size was not calculated because of the retrospective and descriptive nature of the analyses; however, the data were collected for one year.

Ethical approval

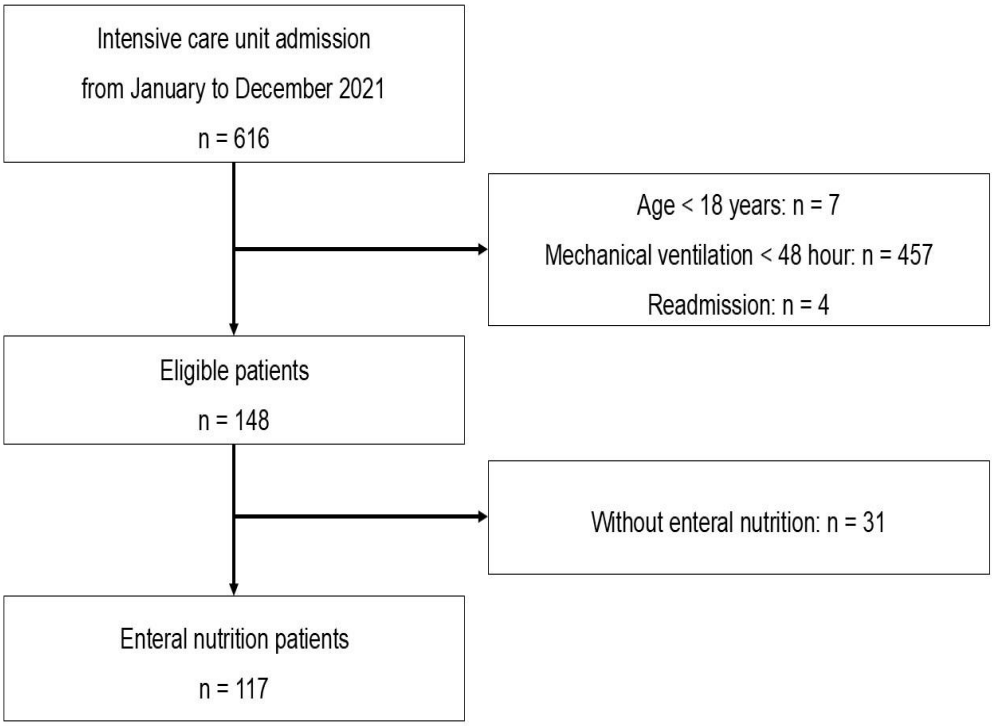
This study was approved by the hospital's Institutional Review Board (approval #R04-138). Because of the retrospective nature of the study, the requirement for informed consent from each patient was waived. All procedures were approved according to the regulations of the University of Tsukuba, which equaled or exceeded the standards set by the Declaration of Helsinki.

RESULTS

A total of 616 patients were admitted to the ICU, and 148 met the eligibility criteria. Of these, 117 patients received ETF and were selected for analysis (Figure 1).

Figure 1

Flow Chart of Patient Selection for the Study of Inappropriate Enteral Tube Feeding Discontinuation



Patient characteristics are shown in Table 1. Of the participants, 75 (51%) were male, median age was 64 years (53–74), median APACHE II score was 24 (16–30), 93 (79%) patients received medical therapy, 29 (25%) had respiratory failure, 25 (21%) had cardiovascular surgery, and 20 (17%) cardiopulmonary arrest. The duration of the median mechanical ventilation was 7 (4–11), the median length of stay was 10 (5–14), and the ICU mortality rate was 15 (13%).

Table 1

Patient Characteristics for the Study of Inappropriate Enteral Tube Feeding Discontinuation

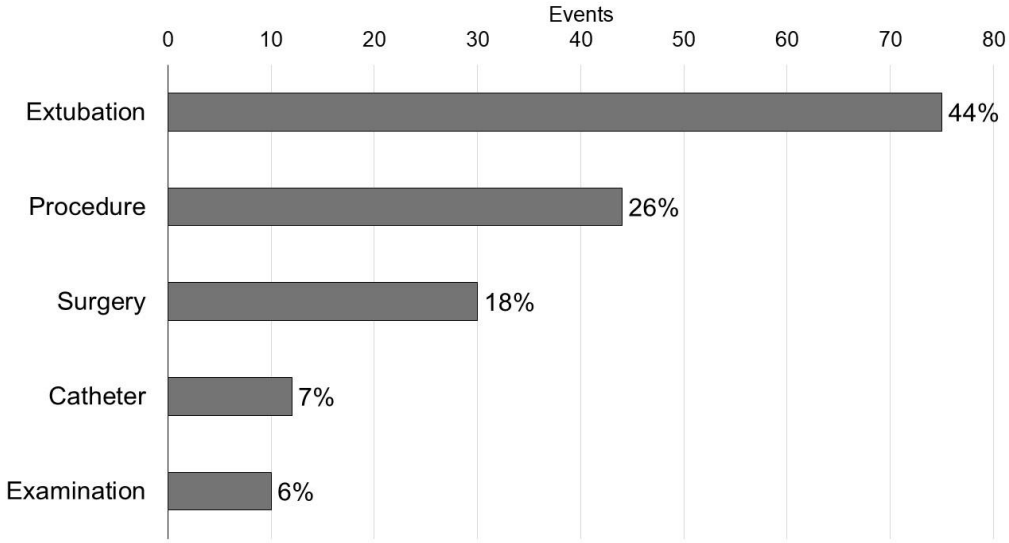
Variable	n = 117
Male, n (%)	75 (51)
Age, median (IQR)	64 (53–74)
APACHE II score, median (IQR)	24 (16–30)
Admission category, n (%)	
Medical	93 (79)
Emergency surgery	17 (15)
Elective surgery	7 (6)
Disease classification, n (%)	
Respiratory failure	29 (25)
Cardiovascular surgery	25 (21)
Cardiopulmonary arrest	20 (17)
Stroke	12 (10)
Heart failure	9 (8)
Sepsis	7 (6)
Trauma	7 (6)
Gastrointestinal surgery	3 (3)
Other	5 (4)
Mechanical ventilation duration, median (IQR)	7 (4–11)
Length of ICU stay, median (IQR)	10 (5–14)
ICU mortality, n (%)	15 (13)

*IQR, interquartile range; APACHE, Acute Physiology and Chronic Health Evaluation; ICU, intensive care unit.

The total number of ETF orders was 2,600, with 22 orders per patient. There were 270 events per 2,600 orders (10%) of ETF discontinuations, of which 171/270 (63%) were planned and 99/270 (37%) were unplanned. Among the 171 planned cases, the three most common causes were extubation (44%), procedure (26%), and surgery (18%) (Fig 2). Among the 99 unplanned cases, the two most common causes were GRV (43%) and nausea and vomiting (19%) (Fig. 3).

Figure 2

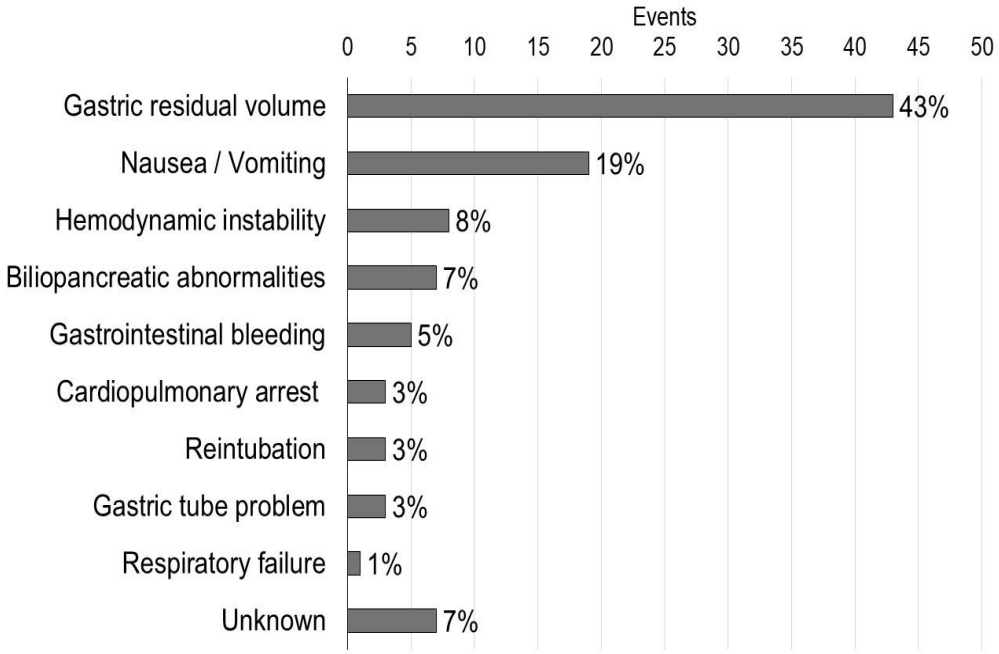
Reasons for Planned Inappropriate Enteral Tube Feeding Discontinuation



*ETF, enteral tube feeding.

Figure 3

Reasons for Unplanned Inappropriate Enteral Tube Feeding Discontinuation

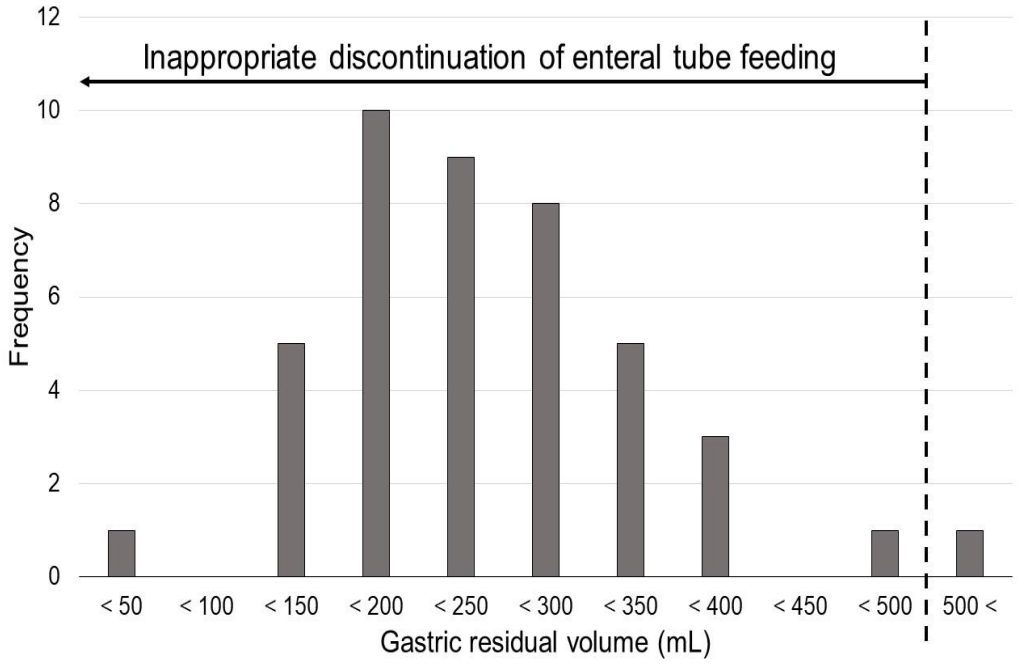


*ETF, enteral tube feeding

Of the 43 ETF discontinuations caused by a GRV, 150–200 mL was reported in 10 (23%), 200–250 mL in 9 (21%), 250–300 mL in 8 (19%), and > 500 mL in 1 (2%) patient (Fig 3). Inappropriate ETF discontinuation related to GRV accounted for 42/99 (42%) of unplanned discontinuations and 42/43 (98%) of discontinuations related to GRV.

Figure 3

Gastric Residual Volume when Inappropriate Enteral Tube Feedings were Discontinued



*This shows the measured GRV when the ETF was discontinued at a high GRV. In these cases, ETF was discontinued due to GRV. Of the 43 patients, 42 (98%) discontinued ETF inappropriately.
GRV, gastric residual volume; ETF, enteral tube feeding.

DISCUSSION

Discontinued ETF occurred in 10% of all orders in critically ill patients. Unplanned discontinuations accounted for 37%, with GRV accounting for the largest percentage (43%). The reason for discontinuation was solely due to high GRV, of which all but one were deemed inappropriate.

The most frequent reasons for ETF discontinuation, excluding those with a GRV < 500 mL, were nausea, vomiting, and hemodynamic instability. Prior studies have also shown that ETF is often discontinued owing to gastrointestinal events and hemodynamic instability (Salciute-

Simene et al., 2021; Uozumi et al., 2017). Therefore, the reasons for ETF discontinuation in the present study were more common in critically ill patients, supporting the results of previous studies.

Possible reasons for the high frequency of inappropriate discontinuation of ETF related to GRV include the lack of a clear protocol for GRV and the nurses' perceptions of GRV. In the subject ICU, individuals assessed GRV based on literature, customary practices, and rules of thumb because of a lack of protocol for GRV. This could have resulted in individual variability in GRV discontinuation criteria. According to a national survey in the United States, approximately 70% of ICU nurses use a GRV of 200 or 250 mL as an indicator for ETF discontinuation (Metheny et al., 2012). In this ICU, more than half of the discontinuations due to GRV resulted in ETF discontinuation at 150–300 mL, indicating that the results were similar to those of the present study. However, guidelines recommend discontinuing ETF at 500 mL or more (Kotani et al., 2016; McClave et al., 2016; Reintam Blaser et al., 2017; Singer et al., 2019). This difference in perception may unnecessarily lead to ETF discontinuation, resulting in reduced nutritional supply and delays in reaching the target ETF amount (Edwards & Metheny, 2000)Therefore, research results and guideline recommendations must be clearly disseminated to increase the awareness of healthcare providers of the GRV criteria for discontinuing ETF.

However, traditional aspiration-based GRV measurements may be inaccurate. Aspirated GRV may be affected by the type of gastric tube, its tip position, and the nature of the stomach contents, resulting in differences between actual and measured GRV (Bartlett Ellis & Fuehne, 2015; Metheny et al., 2005). Furthermore, a recent meta-analysis reported that monitoring GRV by aspiration only reduced vomiting and was not associated with abdominal distention, diarrhea, ventilator-associated pneumonia, ventilatory duration, ICU length of stay, or ICU mortality (Feng et al., 2023). Thus, GRV monitoring increases the workload of nurses and the cost of medical supplies despite its lack of reliability and significant benefits (Tume et al., 2019). As a novel measurement technique, GRV measurement using ultrasonography may be an alternative to conventional aspiration measurement and can be utilized in clinical practice (Ankalagi et al., 2022; Bouvet et al., 2020; Brotfain et al., 2022).

This study has several limitations. First, this was a retrospective, observational study. All data were based on medical records; thus, data without records could not be analyzed. However, this may have minimal impact because the subject facility had to describe GRV and the reason for ETF discontinuation. Second, the study was conducted at a single

institution, and the results are not representative of all ICUs. Third, the enteral feeding content and gastric tube type varied from patient to patient and could not be analyzed. In particular, the gastric tube may underestimate the measured value because GRV is affected by the type, tip position, and nature of the gastric content (Bartlett Ellis & Fuehne, 2015; Metheny et al., 2005). Therefore, future studies should be prospective and multi-center, and the type of gastric tube should be measured in a uniform manner. However, to our knowledge, this is the first study to clarify inappropriate ETF discontinuation related to GRV in critically ill patients.

CONCLUSION

In critically ill patients, ETF was discontinued in 10% of all orders, of which 37% were unplanned discontinuations. High GRV was the most common reason for discontinuation and was identified as inappropriate in most cases. The GRV criteria for discontinuing ETF may need to be further clarified among healthcare providers.

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Funding
This work was supported by Sapporo City University Research Grant No. 2023 Takeshi Unoki.

Competing interests
The authors declare that they have no conflicts of interest.

Data availability
The datasets used and/or analyzed in the current study are available from the corresponding author upon reasonable request.

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