5.3b Strategies to Optimize the Delivery of EN: Monitoring Gastric Residual Volumes

Question: Does not monitoring GRVs compared to monitoring GRVs result in better outcomes in the critically ill adult patient?

Summary of evidence: One multicenter trial (Reignier 2013) and a smaller two-centre trial (Ozen 2016) compared not measuring GRVs to monitoring GRVs with a threshold of 250 mLs. Both trials were level two studies.

Mortality: There were no differences in mortality between the groups that did not check gastric residual volumes vs. the group with a GRVs threshold of 250 ml in the multicentre study (Reignier 2013) or in the two-centre study (Ozen 2016). When the data from these two studies were aggregated, not checking GRVs had no effect on mortality (RR 0.90, 95 % CI 0.61, 1.31, p=0.57, test for heterogeneity I^2=65%, Figure 1).

Infections: There were no significant differences in ICU acquired infections or ventilator associated pneumonia rates between the group that did not check gastric residual volumes vs. the group that did check GRVs in the multicentre study (Reignier 2013). Infections were not reported in the Ozen 2016 study.

LOS & ventilator days: In the multicentre study, there were no significant differences in ICU or hospital LOS between the groups that did not monitor gastric residual volumes vs. the group that monitored GRVs > 250 ml (Reignier 2013), whereas a trend towards a reduction in ICU LOS was reported in no GRV monitoring group in the smaller study (p=0.157, Ozen 2016). Similarly, no differences were seen in duration of mechanical ventilation in the multicentre trial (Reignier 2013), yet a trend towards a reduction in duration of mechanical ventilation in the no GRV monitoring group (p=0.072) was observed in the smaller study (Ozen 2016). The data from these two studies was not aggregated in a meta-analysis due to varying units of reporting.

Other: In both studies, nutrition outcomes were significantly better in the group that did not monitor GRVs i.e., higher proportion of patients achieved caloric target (p<0.001, Reignier 2013); lower cumulative calorie deficit (Reignier 2013, Ozen 2016) and less time to reach target rate (p=0.03, Ozen 2016) although differences in absolute amount of calories received was small and may not be clinically significant, particularly because it does not account for losses due to vomiting. Reignier et al., reported higher rates of vomiting in the group that did not check gastric residual volumes but no differences in diarrhea. Ozen et al., reported no significant differences in the rates of vomiting, diarrhea, abdominal distention or feeding intolerance between the groups that did or not check GRVs.

Conclusions:

In critically ill patients receiving enteral nutrition**,** not monitoring GRVs compared to 250 mL GRV threshold**:**

1. Has no effect on mortality, infections or ICU/hospital length of stay
2. May be associated with a trend towards a reduction in duration of mechanical ventilation
3. May be associated with a lower calorie deficit which is of questionable clinical significance.
4. May be associated with higher rates of vomiting.

Level 1 study: *if all of the following are fulfilled: concealed randomization, blinded outcome adjudication and an intention to treat analysis.*
Level 2 study*: If any one of the above characteristics are unfulfilled.*

Table 1. Randomized studies evaluating not monitoring gastric residual volume in critically ill patients

Study	Population	Methods (score)	Intervention	Mortality # (%)†	Infections # (%)‡
1) Reignier 2013	Mechanically ventilated patients from 9 ICUs requiring EN via NG within 36 hrs after intubation N= 452	C.Random: Yes ITT: Yes Blinding: No (11)	Not monitoring GRV vs. GRV limit of 250 ml q 6 hrs Feeds started at goal rate Vomiting considered an intolerance to EN in both groups	**No GRV** **GRV 250mL** **ICU** 63/227 (28) 61/222 (28) **Hospital** 82/227 (36) 76/222 (34)	**No GRV** **GRV 250mL** **VAP** 38/227 (17) 35/222(16) **ICU acquired** 60/227 (26) 60/222 (27)
2) Ozen 2016	Critically ill medical patients expected to be ventilated and received EN Two centres N=51 of 62	C.Random: Yes ITT: No Blinding: No (6)	Not monitoring GRVs vs. limit of 250 mL q8 hrs 5 days. Both groups EN was to start at 20 mL/hr and increase by 20 mL q 8 hrs until target rate.	**No GRVs** **GRVs 250 mL** 15/26 (57.7) 20/25 (80), p =0.157	NR

Table 1. Randomized studies evaluating not monitoring gastric residual volume in critically ill patients (continued)

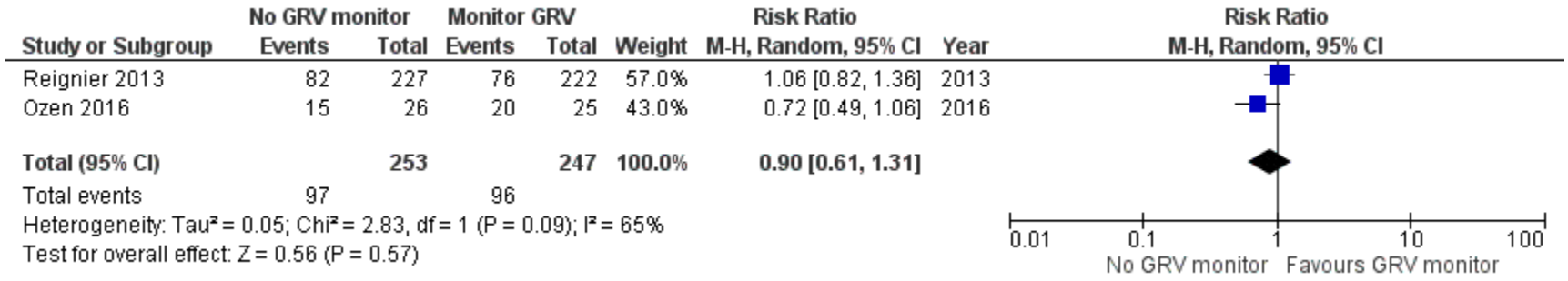
Study	Length of Stay (days)	Mechanical Ventilation (days)	Other
1) Reignier 2013	**No GRV** **GRV 250mL** **ICU** 10 (6-17) 10 (7-17) **Hospital** 17 (9-31) 19 (10-32)	**No GRV** **GRV 250mL** 7 (4-13) 7 (5-13)	**No GRV** **GRV 250mL** **Cumulative calorie deficit Day 0-7, Kcals** 319 (93-1012) 509 (185-1252) **% patients achieving target calorie rate** Higher in No GRV Odds Ratio 4.13, 90% CI 2.20-7.69, p<0.001) **Vomiting** 90/227 (40) 60/222 (27) **Diarrhea** 51/227 (23) 51/222 (23) **EN intolerance** 90/227 (40) 141/222 (64)
2) Ozen 2016	**No GRV** **GRV 250 mL** 27.35 ±24.01 32.96 ±21.81, p =0.157	**No GRV** **GRV 250 mL** 24.85±22.97 31.72±22.29, p=0.072	**No GRV** **GRV 250 mL** **Time to start EN, hrs** 19.58±27.69 28.12±35.81, p=0.66 **Time to reach target intake, hrs** 15.69±4.66 18.76±5.10, p=0.03 **% Calorie intake over 5 days** 84.2±9.2 83.6±10.9, p=0.83 **Calories provided over 5 days** 1228 ± 428 1004 ±264, p=0.029 **Cumulative calorie deficit over 5 days, kcal** 44±61 134±100, p≤0.001 **Daily duration of feeding over 5 days, hrs** 21.2±1.56 18.53±1.7, p≤0.001 **Vomiting** 1/26 (3.8%) 0/25, p =0.32 **Diarrhea** 3/26 (11.5%) 1/25 (4%), p=0.32 **Abdominal distention** 0/26 1/25 (4%), p=0.30 **Feeding intolerance** 1/26 (3.8%) 2/25 (8%), p =0.53

C.Random: concealed randomization
† presumed hospital mortality unless otherwise specified
NR: not reported
GRV: gastric residual volume

ITT: intent to treat; NA: not available
± ( ) : mean ± Standard deviation (number)
ICU: intensive care unit

‡ refers to the # of patients with infections unless specified
RR: relative risk; CI: confidence interval
VAP: ventilator associated pneumonia

Figure 1. Mortality



References

Included Studies

1. Reignier J, Mercier E, Le Gouge A, Boulain T, Desachy A, Bellec F, Clavel M, Frat JP, Plantefeve G, Quenot JP, Lascarrou JB; Clinical Research in Intensive Care and Sepsis (CRICS) Group. Effect of not monitoring residual gastric volume on risk of ventilator-associated pneumonia in adults receiving mechanical ventilation and early enteral feeding: a randomized controlled trial. JAMA. 2013 Jan 16;309(3):249-56. doi: 10.1001/jama.2012.196377.
2. Ozen N, Tosun N, Yamanel L, Altintas ND, Kilciler G, Ozen V. Evaluation of the effect on patient parameters of not monitoring gastric residual volume in intensive care patients on a mechanical ventilator receiving enteral feeding: A randomized clinical trial. J Crit Care. 2016;33:137-144. doi:10.1016/j.jcrc.2016.01.028

Excluded Studies	Reasons
Taylor SJ, Fettes SB, Jewkes C, Nelson RJ. Prospective, randomized, controlled trial to determine the effect of early enhanced enteral nutrition on clinical outcome in mechanically ventilated patients suffering head injury. Crit Care Med. 1999;27(11):2525-2531. doi:10.1097/00003246-199911000-00033	See 3.2: Target Dose EN
Pinilla JC, Samphire J, Arnold C, Liu L, Thiessen B. Comparison of gastrointestinal tolerance to two enteral feeding protocols in critically ill patients: a prospective, randomized controlled trial. JPEN J Parenter Enteral Nutr. 2001;25(2):81-86. doi:10.1177/014860710102500281	See 5.1: Feeding Protocols
McClave SA, Lukan JK, Stefater JA, Lowen CC, Looney SW, Matheson PJ, Gleeson K, Spain DA. Poor validity of residual volumes as a marker for risk of aspiration in critically ill patients. Crit Care Med. 2005 Feb;33(2):324-30.	No clinical outcomes
Juvé-Udina ME, Valls-Miró C, Carreño-Granero A, et al. To return or to discard? Randomised trial on gastric residual volume management. Intensive Crit Care Nurs. 2009;25(5):258-267. doi:10.1016/j.iccn.2009.06.004	See 5.5d: GRV discarding
Montejo JC, Miñambres E, Bordejé L, Mesejo A, Acosta J, Heras A, Ferré M, Fernandez-Ortega F, Vaquerizo CI, Manzanedo R. Gastric residual volume during enteral nutrition in ICU patients: the REGANE study. Intensive Care Med. 2010 Aug;36(8):1386-93. Epub 2010 Mar 16.	See 5.5a: GRV threshold
Poulard F, Dimet J, Martin-Lefevre L, et al. Impact of not measuring residual gastric volume in mechanically ventilated patients receiving early enteral feeding: a prospective before-after study. JPEN J Parenter Enteral Nutr. 2010;34(2):125-130. doi:10.1177/0148607109344745	Not RCT
Kuppinger DD, Rittler P, Hartl WH, Rüttinger D. Use of gastric residual volume to guide enteral nutrition in critically ill patients: a brief systematic review of clinical studies. Nutrition. 2013 Sep;29(9):1075-9.	Systematic review
Williams TA, Leslie G, Mills L, Leen T, Davies H, Hendron D, Dobb GJ. Frequency of Aspirating Gastric Tubes for Patients Receiving Enteral Nutrition in the ICU: A Randomized Controlled Trial. JPEN J Parenter Enteral Nutr. 2014 Sep;38(7):809-16.	See 5.5c: Frequency of GRV monitoring
Chen S, Xian W, Cheng S, et al. Risk of regurgitation and aspiration in patients infused with different volumes of enteral nutrition. Asia Pac J Clin Nutr. 2015;24(2):212-218. doi:10.6133/apjcn.2015.24.2.12	No clinical outcomes
Büyükçoban S, Akan M, Koca U, Eğlen MY, Çiçeklioğlu M, Mavioğlu Ö. Comparison of Two Different Enteral Nutrition Protocol in Critically Ill Patients. Turk J Anaesthesiol Reanim. 2016;44(5):265-269. doi:10.5152/TJAR.2016.92499	See 5.5c: Frequency of GRV monitoring
Tume LN, Bickerdike A, Latten L, et al. Routine gastric residual volume measurement and energy target achievement in the PICU: a comparison study. Eur J Pediatr. 2017;176(12):1637-1644. doi:10.1007/s00431-017-3015-8	Not RCT; Pediatric patients
Pham CH, Collier ZJ, Garner WL, Kuza CM, Gillenwater TJ. Measuring gastric residual volumes in critically ill burn patients - A systematic review. Burns. 2019;45(3):509-525. doi:10.1016/j.burns.2018.05.011	Systematic review
Wang Z, Ding W, Fang Q, Zhang L, Liu X, Tang Z. Effects of not monitoring gastric residual volume in intensive care patients: A meta-analysis. Int J Nurs Stud. 2019;91:86-93. doi:10.1016/j.ijnurstu.2018.11.005	Meta-analysis