Can J Anesth/J Can Anesth (2010) 57:216–221
DOI 10.1007/s12630-009-9248-x

REPORTS OF ORIGINAL INVESTIGATIONS

Orogastric tubes do not improve transesophageal echocardiographic imaging during cardiac surgery: a randomized trial

Les sondes orogastriques n'améliorent pas l'imagerie ÉTO pendant une chirurgie cardiaque – une étude randomisée

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Received: 1 April 2009 / Accepted: 8 December 2009 / Published online: 5 January 2010

Abstract

Introduction *Image quality is often an overlooked consideration that affects the quality and findings of a perioperative transesophageal echocardiography (TEE) study. We undertook a study to evaluate the potential benefit of orogastric (OG) tube insertion following tracheal intubation as a method to improve TEE image quality.*

Methods *In this prospective randomized double-blind controlled trial, 32 adult cardiac surgery patients were randomized to receive either an orogastric (OG) tube with suctioning or no OG tube following tracheal intubation and before TEE probe insertion. Two independent observers graded the quality of related TEE images on a scale from 1 to 4, and the total image scores (total scores out of a possible 20) were compared between groups across five different views. All analyses were by intention to treat.*

Results *For the total scores, there was no difference between the OG and control groups (mean 12.3 [2.1] vs 12.8 [1.8], respectively; $P = 0.7$). There was a numerically small but statistically significant difference in total scores between reviewers (score 2.4 [0.7] vs 2.2 [0.9]; mean difference −0.2; 95% confidence interval −0.4 to −0.02; $P < 0.001$). For the most part, the raters agreed on the scores for each view. Overall, 96% of the total scores were identical or differed by only one point.*

Conclusion *While this study was underpowered to detect small changes in image quality, the use of an OG tube for routine cases did not improve the overall quality of the related images acquired during TEE examination.*

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Résumé

Introduction *La qualité de l'image est une considération souvent négligée qui affecte la qualité et les résultats des études d'échocardiographie transœsophagienne (ÉTO) périopératoire. Nous avons réalisé une étude afin d'évaluer l'avantage potentiel procuré par l'insertion d'une sonde orogastrique (OG) après l'intubation trachéale pour améliorer la qualité de l'image d'ÉTO.*

Méthode *Dans cette étude prospective, randomisée, contrôlée par placebo et à double insu, 32 patients adultes subissant une chirurgie cardiaque ont été randomisés à recevoir soit une sonde orogastrique (OG) avec succion ou pas de sonde OG après l'intubation trachéale et avant l'insertion de la sonde d'ÉTO. La qualité des images d'ÉTO associées a été évaluée sur une échelle de 1 à 4 par deux observateurs indépendants, et les notes totales des* *images (notes totales sur 20 au maximum) ont été comparées entre les groupes pour cinq vues différentes. Toutes les analyses ont été réalisées selon l'intention de traiter.*

Résultats *Pour les notes totales, il n'y a eu aucune différence entre les groupes OG et témoin [moyenne 12,3 (2,1) vs 12,8 (1,8), respectivement]; $P = 0,7$). Il y a eu une différence, petite d'un point de vue numérique mais significative d'un point de vue statistique, entre les notes totales des deux observateurs (note 2,4 (0,7) vs 2,2 (0,9), différence moyenne $-0,2$, intervalle de confiance 95 % $-0,4$ à $-0,02$; $P < 0,001$). Pour chaque vue, il y avait une bonne concordance entre les notes des observateurs. En tout, 96 % des notes totales étaient identiques ou ne différaient que d'un point.*

Conclusion *Bien que cette étude manque de puissance pour détecter les changements mineurs au niveau de la qualité de l'image, l'utilisation d'une sonde OG n'a pas amélioré la qualité globale des images associées acquises par un examen ÉTO dans les cas de routine.*

Transesophageal echocardiography (TEE) has become a standard monitor in many cardiac surgical centres during cardiac surgery, and TEE now has a class I indication for mitral valve repair and a class II indication for most other cardiac procedures.[1] Anesthesiologists rely on echocardiography for both monitoring and diagnosis; therefore, they need clear images for accurate interpretation. Clear images of all views are often difficult to obtain due to a number of factors, including gastric insufflation, which commonly occurs during bag-mask ventilation in the peri-induction period. However, the cause of poor image quality during TEE examination is often uncertain. To minimize the potential impact that results from gastric insufflation, many anesthesiologists routinely insert an orogastric (OG) tube following endotracheal intubation. The purpose of this randomized controlled trial was to determine whether routine OG tube placement improves TEE image quality in cardiac surgical patients.

Methods

Following institutional review board approval, 38 adult patients undergoing cardiac surgery were randomized to one of two groups: either a group of patients who had gastric suctioning via a size 16 or 18 French OG tube (Benlon Inc., Oakville, ON, Canada) inserted prior to TEE imaging or a control group of patients who did not have an OG tube placed. Inclusion criteria included any patients aged 18 to 75 yr who were scheduled for elective cardiac surgery through a midline sternotomy. All patients gave their written consent to participate in the study. Demographic data were collected for each patient, including height, weight, age, gender, presence of diabetes, hiatus hernia, temporomandibular distance, Cormack Lehane score, grade of intubation, and number of tracheal intubation attempts. Immediately prior to induction of anesthesia, randomization was achieved by a coin toss to allocate each patient to one study arm or the other. In this manner, the allocation sequence did not require concealment, and there was strict adherence to the randomization sequence.

Anesthesia was induced in all subjects with propofol, rocuronium, and fentanyl, followed by bag-mask ventilation with 100% oxygen, taking care to ensure that airway pressures did not exceed 20 cm H_2O with no more than five manual breaths prior to intubation. Following tracheal intubation using direct laryngoscopy, patients allocated to the OG tube insertion group had an OG tube inserted, which was then suctioned for 30 sec at > -110 cm H_2O. Correct OG tube placement was confirmed by observation of bilious content within the suction canister or by auscultation over the patient's abdomen during OG tube suctioning (no air was injected). No attempt was made to ascertain whether complete gastric drainage had been achieved. The OG tube was removed following suctioning. All patients then underwent TEE examination as per routine for cardiac surgical patients at our institution. Five images were obtained for assessment of image quality: mid-esophageal four chamber (ME4C), transgastric basal (TGB), transgastric midpapillary (TGM), transgastric apical (TGA), and deep transgastric (DTG) views. All images were graded on a scale from 1 to 4 based on image quality (Appendix 1). This scale was used because it is naturally intuitive and the effective use of a similar scale was reported previously.[2]

All grading was completed off-line by two cardiac anesthesiologists, each with more than four years of experience. All imaging was conducted on the same platform, a SONOS 5500 (Philips Medical Systems, Bothell, WA, USA) using the Omni II transducer (4-7 MHz). All images were digitally-stored single loops representing the current routine care at our institution.

The anesthesiologists who reported the grading scores did so independently and were blinded to patient allocation. In addition, one author (D.B.) repeated all measurements one year after the initial grading was performed. The primary outcome of interest was the mean total score (out of a maximum possible score of 20) for all five views.

Data analysis

Mean total scores and standard deviation (SD) were reported for TEE image quality across the five views for the two reviewers in aggregate. In cases where data were missing for one observer, the mean total score for the patient was calculated for the single observer only, without imputation for missing data in order to prevent biases due to imputation for small data sets. Also, mean scores were reported separately for each of the five views and for each of the reviewers. Mean scores were compared using the unpaired *t* test. Two-tailed *P* values were calculated, and values <0.05 were considered statistically significant.

In a sensitivity analysis, median total scores and interquartile ranges were also reported separately for each of the five views and for each of the reviewers. The Mann-Whitney U test was used to compare median total scores between the two groups, since non-parametric statistics may be more appropriate for ordinal data. However, the results did not change materially, and only the more intuitive means (standard deviation) are presented here.

In a post-hoc analysis, we dichotomized the median total scores into "interpretable views" with a score of 1 or 2, and "uninterpretable views" with a score of 3 or 4. This dichotomized analysis was performed in order to assess the clinically relevant question whether OG tube insertion and venting resulted in improved TEE views that are acceptable for decision-making. The Fisher's exact test was used to determine whether the number of uninterpretable views was reduced by using OG tube suctioning rather than no OG tube insertion.

For each patient and each TEE view, intraclass correlations (ICC) were calculated to assess both the agreement (i.e., reliability) between observers and the agreement over time for one observer (D.B.). The intraclass correlation ranges from 0 (chance agreement) to 1 (perfect agreement).[3] The higher the ICC, the greater the correlation; <0.4 was considered low agreement, 0.41-0.60 moderate agreement, 0.61-0.80 full agreement, and 0.81-1.00 almost perfect agreement, as previously suggested.[4]

A sample size calculation was performed *a priori*, and it was estimated that 19 patients would be needed in each study arm to expect an absolute improvement of five points out of a total of 20 points in the nasogastric (NG) tube group over an expected score of 12 out of 20 points in the control group (alpha = 0.05 and a power of 80%), with an estimated SD of 20. Data were analyzed using SPSS version 15.0 and R version 2.5 (SPSS Inc., Chicago, IL, USA).

Results

Thirty-eight patients were assessed for eligibility, met inclusion criteria, and were enrolled throughout April 2007 to December 2007. Two patients declined participation following recruitment, and images were lost from four others (two per group), leaving complete data for a total of 32 patients (14 patients in the OG group and 18 patients in the control group). Five of 32 patients had their TEE images interpreted by one reviewer only. Baseline characteristics are presented in Table 1. No clinically relevant differences were detected between the groups at baseline. There were no adverse events reported as a result of study intervention. The mean and SD of scores for each view are presented in Table 2.

Table 1 Patient characteristics

	OG Tube	No OG Tube
Patients (*n*)	14	18
Gender (female)	2	3
GERD	4	1
Diabetes Mellitus	2	4
Temporomandibular Distance (cm)	6.2	5.9
Require > 5 bag-mask ventilations	2	4
Mallampati Score mean (SD)	1.8 (0.69)	1.7 (0.67)
Cormack Score mean (SD)	1.6 (0.77)	1.6 (0.85)
Body Mass Index Mean (SD)	30 (4.2)	30 (6.8)

OG = orogastric; GERD = gastroesophageal reflux disease; SD = standard deviation

There was no difference between the OG group and the control group in terms of the primary outcome, i.e., total score out of a possible 20, (mean [SD] total score 12.3 [2.1] *vs* 12.8 [1.8], respectively; $P = 0.47$) (Figure 1). Similarly, there was no difference between groups regarding median (interquartile ranges) (Table 3). This result was confirmed by ordinal logistic regression for total scores *vs* OG status, showing no relationship between use of the OG tube and assigned scores.

Total scores were similar between reviewers when all scores were combined as an aggregate across the five views ($P = 0.47$) (Table 2). However, there was a numerically small but statistically significant difference in scores between reviewers (mean score 2.4 [0.7] *vs* 2.2 [0.9]; mean difference -0.2; 95% confidence interval -0.4 to -0.02; $P = 0.03$). This difference was largely due to differences in assigned scores between reviewers in the TGB and DTG views. Intra-rater reliability was 0.81. The ICC between observers was moderate in strength for each view considered alone (ME4C 0.59, TGB 0.46, TGM 0.60, TGA 0.52, and DTG 0.49). When total scores across all views were considered, the ICC was moderately high (0.65) for inter-observer observations. Intra-observer measurements, which were available for 23 patients, had a moderately high (0.67) ICC. Overall, for interclass observations, less than 4% of scores differed by more than one point between reviewers for all of the views combined, and for intraclass observations, no scores differed by more than one point.

Table 2 Mean scores for each view (mean score of both observers)

	OG Tube		No OG Tube		Mean difference (95% confidence interval)	*P* value
	Mean	(SD)	Mean	(SD)		
Mid Esophageal Four Chamber	2.2	(0.60)	2.1	(0.56)	0.1 (−0.4 to 0.5)	0.7
Transgastric Basal	2.0	(0.59)	2.1	(0.55)	−0.1 (−0.5 to 0.3)	0.6
Transgastric Mid	2.2	(0.64)	2.4	(0.75)	−0.2 (−0.7 to 0.3)	0.5
Transgastric Apical	2.7	(0.95)	2.7	(0.79)	0 (−0.7 to 0.7)	1.00
Deep Transgastric	2.2	(0.89)	2.6	(0.66)	−0.4 (−1.0 to 0.2)	0.2
Total Score	12.3	(2.1)	12.8	(1.8)	−0.5 (−2 to 1)	0.5

OG = orogastric; SD = standard deviation

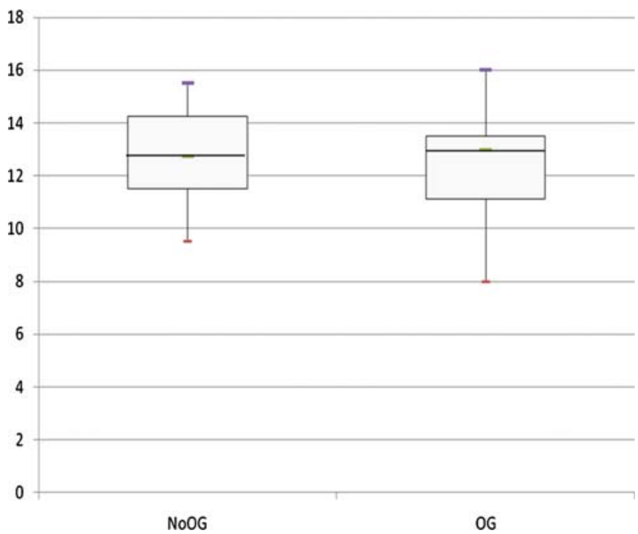

Fig. 1 Total cumulative score for the no orogastric tube (control) group *vs* the orogastric tube group Box plot of mean cumulative composite scores for the orogastric tube group *vs* the no orogastric tube (control) group. The median and interquartile (1st thru 3rd) ranges are displayed along with the minimum and maximum values

Discussion

This randomized controlled trial is novel because a significant benefit in improving TEE image quality in the perioperative setting is not demonstrated from routine orogastric tube insertion and drainage. The findings have direct clinical relevance. While great emphasis has been placed on establishing optimum methods of recording and storing TEE images to allow for accurate cardiac diagnosis and monitoring, evaluation of related techniques, such as gastric suctioning, has largely been ignored. Unlike the ambulatory setting, perioperative events, including pre-intubation positive pressure ventilation and difficult intubation, may contribute to a reduction in image quality during the perioperative period. Unfortunately, our study does not support the routine use of OG tubes to improve image quality.

We found a decrease in our total score of only 0.5 out of 20, implying an improvement in one grade in one view in every two patients. Even though OG tube insertion is not a risky procedure, there is always a slight risk of mucosal tear or malposition. This would suggest that further study to identify patients at high risk for poor images is warranted, as this cohort may have the greatest benefit from insertion of OG tubes. We also examined, in post hoc analysis, whether the number of poor images (grade 3-4) and good images (grade 1-2) was different between the two groups; however, no consistent trend was observed. There may be several reasons why the OG tube made no difference to image quality. First, given the induction protocol of the study, which limited peak mask pressure to < 20 cm H_2O, it is likely that few patients experienced gastric distention

Table 3 Median scores and interquartile ranges (IQRs) for all groups

Medians	Total			OG Tube			No OG Tube		
	All	D.B.	II	All	D.B.	II	All	D.B.	II
All views	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)
ME4c	2 (1)	2 (0.5)	2 (1)	2 (1)	2 (0.75)	2 (0.5)	2 (0.75)	2 (0)	2 (1)
TGB	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)
TGM	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2.5 (1)	2 (1)	2 (1)	2 (1)
TGA	3 (1)	2.5 (1)	3 (0)	3 (1)	2 (1)	3 (0)	3 (1)	3 (1)	3 (1)
DTG	2 (1)	2 (1)	3 (1)	2 (1)	2 (0.5)	2 (1)	3 (1)	2 (1)	3 (1)

OG = orogastric; D.B. = one of the authors; ME4c = mid-esophageal four chamber; TGB = transgastric basal; TGM = transgastric mid-papillary; TGA = transgastric apical; DTG = deep transgastric related to mask ventilation.[5-7] It is still possible that the use of an OG tube may improve image quality in patients who have large gastric air volumes, such as in difficult intubation or difficult mask ventilation. Another cause for a lack of improvement in image quality may have been an inability to place the OG tube in the stomach or to suction fully all air in the stomach.[8] The intent of the study, however, was to examine routine practice, which involves minimal insufflation of the stomach along with placement of an OG tube without fluoroscopic guidance. Several studies have also shown that the volume of aspirated contents with an OG tube is close to the volume with other methods, including endoscopy.[9,10] Again, the criteria used to confirm OG tube placement is routine practice in the operating room (OR) and so best represents current practice.

Image quality is an ongoing concern for sonographers/echocardiographers, as ultrasound imaging takes place at the bedside or OR table sometimes under less than ideal imaging conditions. Image quality comparisons between digital image storage and analogue image storage have been studied, as have comparisons between the use of lightweight hand-held machines and heavier more robust models.[11-13] Most of these studies performed measurements using two imaging modalities and then compared measurements. However, a previous publication did employ a rating scale of image quality similar to the one used in this study.[2]

Limitations of the present study

The patients enrolled in this trial were typical cardiac surgery patients, and no attempt was made to select patients at a potentially higher risk of gastric insufflation (obese patients or those with potentially difficult airways). We also chose to limit insufflation pressure and the number of bag-mask breaths before tracheal intubation, thus our patient group likely represents a low-risk cohort. The anesthesiologist inserting the NG tube was also the anesthesiologist acquiring the images. Although every attempt was made to attain the best possible images, bias in image acquisition cannot be ruled out.

Nasogastric tube position was confirmed clinically; however, better results may have been obtained through fluoroscopy or another method to confirm NG placement. Endoscopy may even be considered in order to ensure a truly empty stomach; however, it may be associated with its own risk of insufflation and is not a clinically practical solution.

Finally, this study was designed to show significance if an improvement of five points in the total score was observed. This approach was chosen as it was considered as being clinically relevant (improvement in one grade in each view). The benefit of an OG tube on image quality may not be as dramatic as this and may improve certain views (deep transgastric) more than others. This study was not powered to identify improvements in single views, but it does suggest that the deep transgastric views may be improved to a greater degree than other views.

In conclusion, this randomized double-blind trial suggests that use of an OG tube and suction prior to TEE in routine cardiac surgery cases does not significantly improve image quality compared with standard of care without OG tube suction. Further studies may be warranted to identify patients at greatest risk of poor image quality, i.e., those who may benefit most from gastric suctioning to improve image quality.

Competing interests None declared.

Appendix 1: Grading of transesophageal echocardiographic images

Grade 1 Excellent quality, with wall structure and motion clearly visualized and measurements easy to perform.

Grade 2 Good quality, adequate for interpretation but quality could be improved.

Grade 3 Poor quality, with difficulty identifying all structures clearly and difficulty in making measurements.

Grade 4 Very poor quality, unable to identify structures, perform measurements, or make calculations.

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