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RESEARCH LETTER

Aspiration pneumonia following oncologic digestive surgery: Proposal for a classification

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1 | INTRODUCTION

Postoperative aspiration pneumonitis (POAP) is a rare (1%) but worrying complication with a high mortality rate (up to 30%).[1-3] General anesthesia combined with gastrointestinal surgery induces digestive tract paralysis with the risk of delayed gastric emptying and consequent POAP. In the last two decades, efforts to decrease perioperative opioid use,[4] together with the rise of minimally invasive surgery, have reduced the surgical impact on digestive motility. In contrast, enhanced recovery after digestive surgery leads to decreased routine gastric tube feeding and increased early postoperative feeding,[5-8] which may induce gastric emptying and increase the risk of POAP, which remains a constant risk after digestive surgery, with various effects ranging from isolated radiologic signs to severe pneumonitis with multiorgan failure. To date, there have been no definitions or grading schemes for POAP, and it is difficult to draw realistic comparisons among perioperative drugs or procedures that could be effective in reducing POAP. Therefore, the present study seeks to develop a simple and reliable POAP classification that could facilitate relevant comparisons of preventive measures and postoperative courses.

2 | METHODS

2.1 | Patient selection and POAP definition

A retrospective review was conducted of all patients who experienced POAP after oncologic digestive surgery at a tertiary cancer center (Institut Paoli-Calmettes, Marseille, France) from January 1, 2010, to December 31, 2018. The diagnosis of POAP was defined, starting at the beginning of postoperative day 1 (POD1) as (a) vomiting followed by immediate pulmonary failure and/or (b) clinical and radiological right or bilateral pneumonitis in a patient with gastric emptying syndrome and/or (c) digestive fluid identified during bronchial aspiration. Patients who had experienced aspiration during surgery were excluded. POD1 was defined as commencing at the conclusion of surgery.

2.2 | POAP classification

After confirmation of the diagnosis, POAP was graded according to an ABC classification based on respiratory management in the first 24-hours. Grades A, B, and C corresponded to POAP with nasal standard oxygen therapy (a), noninvasive ventilation or high-flow oxygen therapy providing positive-pressure airway support through a face or nasal mask without the use of an endotracheal tube (b), and orotracheal intubation (OTI) (c), respectively.

2.3 | Study parameters

The variables evaluated included classic epidemiologic, surgical and postoperative data, history of neurologic or psychiatric diseases/disabilities, ongoing treatments, routine gastric tube at patient

TABLE 1 Characteristics of the 34 POAP patients

Gender ratio (M/F)	2 (23/11)
Mean age (range)	68 (47-82)
Mean BMI (range)	25.7 (19-42)
Diabetes (%)	9 (26)
History of abdominal surgery (%)	17 (50)
History of neurologic/psychiatric diseases/disabilities (%)	9 (26)
Ongoing treatments (%)	
Anticoagulant	13 (38)
Cardiovascular	17 (50)
Antalgics	4 (12)
Opioids	4 (12)
Neurologic/psychiatric	9 (26)
Diabetes	9 (26)
Others	22 (65)
None	2 (6)
ASA score (%)	
1-2	15 (44)
3	19 (56)
Neoadjuvant treatment (%)	16 (47)
Chemotherapy	12 (35)
Chemoradiation	4 (12)
Emergency surgery (%)	9 (26)
Laparotomy approach (%)	27 (79)
Type of surgery (%)	
Upper GI	4 (12)
Liver	6 (18)
Pancreas	9 (26)
Small bowel	6 (18)
Colon	6 (18)
Rectum	5 (15)
Spleen	1 (3)
Other	2 (6)
Intraoperative blood loss > 500 mL (%)	9 (26)
Mean anesthesia duration (min) (range)	278 (40-620)
Postoperative alimentation (%)	
GT until transit recovery	9 (26)
No GT/no feeding until transit recovery	12 (36)
Oral feeding POD1	13 (38)
Mean delay of POAP from surgery (days) (range)	4 (1-13)
POAP grading (%)	
A	12 (35)
B	12 (35)
C	10 (30)
Number of lung quadrants involved (%)	
None	6 (18)
1	6 (18)
2	12 (36)
3	6 (18)
4	4 (10)
Morbidity (%)	
Clavien-Dindo ≥3	13 (38)
Clavien-Dindo 5	3 (9)
Mean ICU LOS (days) (range)	12 (1-26)
Mean hospital LOS (days) (range)	24 (4-89)
Readmission (%)	6 (18)

Abbreviations: BMI, body mass index; GT, gastric tube; ICU, intensive care unit; LOS, length of stay; POAP, postoperative aspiration pneumonitis; POD1, postoperative day 1.

awakening, feeding during POD1, first chest X-ray imaging after the POAP diagnosis, morbidity and 90-day mortality according to the Clavien-Dindo classification, and length of stay (LOS) and readmission.

2.4 | Statistical analysis

Data analyses were performed using SPSS version 24 (IBM Corp., Armonk, New York). Categorical factors were compared using Fisher's exact test or chi-squared test, and continuous variables were compared using Student's *t*-test. Multivariate analysis was not conducted due to the small sample size. Statistical significance was set at $P < .05$.

2.5 | Ethics approval

The study was approved by the institutional review board of the Institut Paoli-Calmettes. Informed consent was waived because of the retrospective design of the study.

3 | RESULTS

During the study period, intra-abdominal surgery for various digestive malignancies was performed in 4986 patients. The study population included the 34 patients (0.7%) who were diagnosed with POAP in a mean of 4 days (range 1-13) after surgery. Patient characteristics are summarized in Table 1. On univariate analysis, factors influencing mortality were POAP grading ($P = .02$), the number of quadrants involved at the first chest X-ray ($P < .01$), and oral feeding at POD1 ($P = .048$).

3.1 | Classification

Grades A, B, and C POAP were diagnosed in 12 (35.3%), 12 (35.3%), and 10 patients (29.4%), respectively (Table 2). When comparing the three groups, there were no differences in terms of patient characteristics, type of surgery, or pre- or intraoperative data, except that patients with grade C POAP had a higher rate of intraoperative blood loss, and we did not identify factors associated with a high risk of POAP. The number of quadrants involved at the first chest X-ray was significantly different according to each grade ($P < .01$). The mortality

TABLE 2 Patient characteristics according to the proposed ABC classification

	Grade A (n = 12)	Grade B (n = 12)	Grade C (n = 10)	*P*-value
Gender ratio (M/F)	1.4 (7/5)	11 (11/1)	1 (5/5)	.1
Mean age (±SD)	69 (13)	67 (8.3)	67 (10.1)	.96
Mean BMI (±SD)	26.3 (5.5)	25.3 (4.2)	25.4 (6.6)	.76
Diabetes (%)	2 (17)	6 (50)	1 (10)	.1
History of abdominal surgery (%)	6 (50)	8 (67)	3 (30)	.23
History of neurologic/psychiatric D/D (%)	3 (25)	2 (17)	4 (40)	.55
Ongoing treatments (%)				
Anticoagulant	4 (33)	5 (43)	3 (30)	.91
Cardiovascular	5 (41)	6 (50)	6 (60)	.72
Antalgics	1 (8)	0	3 (30)	.29
Opioids	0	1 (8)	3 (30)	.29
Neurologic/psychiatric	3 (25)	3 (25)	3 (30)	.34
Diabetes	2 (17)	3 (25)	4 (40)	.77
Others	9 (75)	8 (67)	5 (50)	.51
None	0	1 (8)	1 (10)	
ASA score (%)				1
1-2	6 (50)	5 (42)	4 (40)	
3	6 (50)	7 (58)	6 (60)	
Emergency surgery (%)	2 (17)	4 (33)	3 (30)	.7
Laparotomy approach (%)	9 (75)	11 (92)	7 (70)	.45
Type of surgery (%)				
Upper GI	2 (17)	2 (17)	0	.52
Liver	3 (25)	2 (17)	1 (10)	.85
Pancreas	2 (17)	2 (17)	5 (50)	.14
Small bowel	1 (8)	3 (25)	2 (20)	.64
Colon	4 (33)	1 (8)	1 (10)	.32
Rectum	2 (17)	2 (17)	1 (10)	1
Spleen	0	1 (8)	0	1
Other	0	1 (8)	1 (10)	.74
Blood loss > 500 mL (%)	0	1 (8)	4 (40)	**.02**
Mean anesthesia duration (min) (±SD)	276 (120)	245 (122)	318 (183)	.56
Postoperative alimentation (%)				
GT until transit recovery	2 (17))	4 (33)	3 (30)	.57
No GT/no feeding until transit recovery	6 (50)	5 (42)	1 (10)	.09
Feeding POD1	4 (33)	3 (25)	6 (60)	.3
Mean delay from surgery (days) (±SD)	5 (3.8)	3 (3.2)	3 (1.8)	.33
Morbidity (%)				
Clavien-Dindo ≥3	0	3 (25)	10 (100)	**<.01**
Clavien-Dindo 5	0	0	3 (30)	**.02**
Number of lung quadrants involved (%)				**<.01**
None	2 (17)	3 (17)	1 (1)	
1	6 (50)	0	0	
2	4 (33)	7 (58)	1 (11)	
3	0	2 (25)	4 (44)	
4	0	0	4 (44)	
Mean ICU LOS (days) (±SD)	10 (4.6)	11 (5.4)	18 (2)	**.01**

(Continues)

TABLE 2 (Continued)

	Grade A (n = 12)	Grade B (n = 12)	Grade C (n = 10)	*P*-value
Mean hospital LOS (days) (±SD)	19 (9)	27 (21.6)	26 (15)	.24
Readmission (%)	1 (8)	1 (8)	4 (57)	**.04**

Note: Grade A and B were compared to grade C.
Bold values indicate statistical significance.
Abbreviations: BMI, body mass index; D/D, diseases/disabilities; ICU, intensive care unit; LOS, length of stay; POAP, postoperative aspiration pneumonitis; POD1, postoperative day 1.

rate was higher in patients with grade C POAP (30% vs 0 in grades A and B; P = .02) as was the LOS in the ICU (P = .01) and the readmission rate (P = .04). We did not identify postoperative factors associated with reduced POAP severity.

4 | DISCUSSION

We showed that POAP was rare (0.7%) but severe, with a significant overall mortality rate (8.8%) possibly increasing to 30% in high-risk cases (grade C).

4.1 | Prevention of POAP

Gastric emptying and digestive tract paralysis are among the major burdens of digestive surgery. They contribute to postoperative discomfort and can lead to POAP of various severities. These phenomena provoke asymptomatic microinhalation that is only revealed by radiologic right lung condensation; or they may manifest as acute hypoxic respiratory failures requiring prompt resuscitation and OTI in case of massive vomiting. To date, no pre- or intraoperative drugs or procedures have been effective in preventing POAP. Although oral feeding at POD1 was linked to mortality on univariate analysis, our small sample size prevented any definitive conclusions. Indeed, the gastric tube is no longer used postoperatively in scheduled surgery as the tube itself can provoke adverse events.[6,9-11]

4.2 | Postoperative feeding

In our series, we did not identify a policy on postoperative alimentation that could increase the risk of POAP. This reinforces the actual strategy of light oral intake from POD1 in the majority of scheduled digestive surgeries. Because the mean time to POAP was 4 days, we supposed that gastric emptying started immediately after patient awakening and worsened during this short period. Thus, special attention must be paid to the tolerance of early feeding.[8] Early identification and follow-up of gastric emptying is a field of current research interest,[12] because no validated bedside radiologic examination has proven to be reliable. Nevertheless, gastric ultrasound has been tested in a small series and appeared to be helpful in determining the use of a gastric tube in patients with worsening gastric emptying.[13,14]

4.3 | Usefulness of the ABC classification

Our results support the identification of two categories of patients: those who required an OTI during the first 24 hours after POAP diagnosis (grade C) and those who did not (grades A and B). We conclude that the ABC classification is useful as it is also consistent with a previous classification based on the first chest X-ray and the number of lung quadrants involved.[15,16] This classification could be used to ensure a reliable comparison between series, to compare new drugs or examinations that could help in reducing POAP, and to evaluate new postoperative strategies in the setting of gastric emptying and oral feeding.

We emphasize that our findings are limited because of the retrospective study design and the relatively low number of patients that limits the statistical power. Therefore, subgroup analyses were limited, and conclusions should be drawn with caution.

5 | CONCLUSIONS

POAP is a rare but severe event. Nevertheless, we advocate the early use of a nasogastric tube if delayed gastric emptying or ileus is suspected, because of the high mortality associated with unpredictable grade C POAP. This preliminary study suggests that the ABC classification may be useful to estimate patient prognosis and may facilitate multicenter studies comparing the capacity of new drugs or procedures to reduce POAP incidence and severity.

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CONFLICT OF INTEREST

The authors declare that they have no competing interest.

AUTHOR CONTRIBUTIONS

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All authors have read and approved the final version of the manuscript.

Jonathan Garnier had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

DATA AVAILABILITY STATEMENT

The data sets generated and/or analyzed during the current study are not publicly available because of patient privacy concerns; however, they are available from the corresponding author upon reasonable request.

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