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Research Paper

Impact of merging two university hospitals on surgical outcome after esophagogastric and hepato-pancreato-biliary surgery: Results from a retrospective study

E.W. Ingwersen, MD [a,b], W.T. Stam, MD [a,b], L.J. van Kesteren, MD [a], I.J.A. Wissink, MD [c,d], M.I. van Berge Henegouwen, MD PhD [b,e], M.G. Besselink, MD [b,e], O.R. Busch, MD PhD [b,e], J.I. Erdmann, MD PhD [b,e], W.J. Eshuis, MD PhD [b,e], S.S. Gisbertz, MD PhD [b,e], G. Kazemier, MD PhD [a,b], D.L. van der Peet, MD PhD [a,b], R.J. Swijnenburg, MD PhD [b,e], B. Zonderhuis, MD [a,b], F. Daams, MD PhD [a,b,*]

[a] Amsterdam UMC location Vrije Universiteit Amsterdam, Department of Surgery, Amsterdam, the Netherlands
[b] Cancer Center Amsterdam, the Netherlands
[c] Division of Infectious Diseases, Department of Medicine, University of Amsterdam, Amsterdam UMC, Amsterdam, the Netherlands
[d] Department of Intensive Care, University of Amsterdam, Amsterdam UMC, Amsterdam, the Netherlands
[e] Amsterdam UMC location University of Amsterdam, Department of Surgery, Amsterdam, the Netherlands

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ABSTRACT

Background: Due to centralization and super-specialization in medicine, hospital mergers are increasingly common. Their effect on postoperative outcomes in highly specialized surgical departments is unclear. As quality metrics often worsen after major organizational changes, preservation of quality of care during an hospital merge is of the utmost importance.
Objective: To evaluate the effect of a merger of two Dutch university hospitals on quality of surgical care, volume, and timeliness of care.
Methods: The upper gastro-intestinal and hepato-biliary-pancreatic sections merged on the 27th of January 2020 and the 31th of May 2021 respectively. Outcomes of all adult surgical patients were compared six months before and six months after the merger. Short-term quality metrics, volume, and timeliness of care were assessed.
Results: Overall, a cohort of 631 patients were included of whom 195 were upper gastro-intestinal (97 prior to the merger, 98 after the merger) and 436 (223 prior to the merger, 213 after) hepato-biliary-pancreatic patients. There were no differences in mortality, readmission, number and severity of complications, volume, and timeliness of care six months post-merger as compared to before merger.
Conclusion: This study shows that a hospital merger of two university hospitals can be performed without jeopardizing patient safety and while benefitting from centralization of highly specialized care and enhancement of medical research.
Key message: This study investigated the impact of a merger of two Dutch university hospitals on quality of care, timeliness of care, and volume. It showed no deterioration in the evaluated short-term quality metrics, volume or timeliness for upper GI and HPB surgery, suggesting that a hospital merger of two university hospitals can be performed safely, while benefitting from centralization of highly specialized care and enhancement of medical research.

Introduction

Worldwide there is an increase in hospital mergers [1]. In the Netherlands, the introduction of managed competition in 2006 led to a wave of hospital mergers. From January 2006 almost 30 Dutch hospitals have merged. Potential positive effects of hospital mergers on quality of care (QoC) by centralization and super-specialization, include creation of synergies in clinical forces and material, effects on volume, timeliness of care, and increased efficiency and finance. Theoretically,

Abbreviations: QoC, Quality of Care; GI, gastrointestinal; HPB, hepato-biliary-pancreatic; AMC, Academic Medical Center; VUmc, Free Univeristy Medical Center.

* Corresponding authorat: Amsterdam UMC location Vrije Universiteit Amsterdam, Surgery, De Boelelaan 1117, Amsterdam, the Netherlands.
E-mail address: f.daams@amsterdamumc.nl (F. Daams).

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negative effects include increased bureaucracy and a weakened level of competition resulting in decreased incentives for quality improvement in a market-based system [2]. The effects of general hospital mergers on QoC remain uncertain due to inconsistent findings [3,4], but they might be promising for university hospitals [5,6]. For university hospitals merging can be an opportunity to facilitate further concentration of typical academic high-complex-low-volume healthcare. Multiple studies have shown the benefits of increased volumes of high-complex healthcare on QoC, which is why volume norms for many complex procedures are generally accepted [7,8]. In 2017, the Dutch authority for consumers and markets conducted a major study in the Netherlands on the effect of general hospital mergers on the QoC and found no improvement in the QoC after the merger [9]. Recently, Wang et al. found a temporary increase in overall hospital mortality immediately after a merger, that recovered to a significant lower mortality two to three years later. Temporary decreased quality outcomes are common after major organization changes [5]. Therefore, the period after organization change is an important window, in which deterioration in QoC should be prevented, and acted upon if necessary.

A merger of two university and tertiary centers is unprecedented in the Netherlands and its effect on the short-term QoC, volume, and timeliness of care on highly specialized departments, such as upper gastrointestinal (GI) and the hepato-biliary-pancreatic (HPB), is more or less a conundrum. The aim of this study is to evaluate whether quality of surgical care for oncological HPB and upper GI procedures has been maintained six months after a Dutch university hospital merger. Furthermore, this study investigates the influence of the merger on the volume and timeliness of care. The hypothesize of this study was that the merger did not influence quality of surgical care, volume, or timeliness of care.

Methods

This study retrospectively collected QoC data from electronic health records (EHRs). Data concerning the volume and timeliness of surgical care were extracted from a prospectively collected operating room (OR) planning database. Data were evaluated by two independent researchers (EWI and LJK) to check the correctness of the registered complications and supplement the extracted data in case of missing input. Any discrepancies in the data were assessed by a senior author (FD). The STROBE guidelines were followed to ensure correct reporting of the study methods and results [10]. Ethical approval for the data used for this study was waived by the local review board.

Setting. In 2018 the executive boards of the Academic Medical Center (AMC) and the Free University Medical Center (VUmc) conducted a horizontal merger into the Amsterdam University Medical Center (UMC), whereafter harmonization and integration processes was started [11]. To date, the legal merging for the hospitals is still ongoing, but both affiliated universities will remain different legal entities. Finalizing this requires a national political adjustment of legislation concerning the act on higher education. Currently this process has been set in motion. As a practical implication, EHRs cannot be exchanged between the two locations without consent of patients, for example. Prior to the merger, a director was appointed for every department managing both locations. Next to this, a multidisciplinary lateralization steering group was responsible for all the practical issues concerning the merger. Thirdly, a steering group was established for the harmonization and integration processes. The hospitals, both situated in Amsterdam, the Netherlands, have a physical distance of approximately 12 km. The AMC was a tertiary care university hospital, facilitating 1002 clinical beds with 8720 employees (7354 full-time equivalents [FTEs]) [12]. The VUmc was a tertiary care university hospital, facilitating 733 clinical beds with 7380 employees (6156 FTEs) [13]. Since the merger, half of the specializations are centered in the building of the former AMC hospital and the other half in the building of the former VUmc hospital. Both the upper GI and HPB surgical care were transferred to the building of the former VUmc hospital, with preservation of the operating room capacity. Before the merger, 3 Upper GI surgeons and 4 HPB surgeons worked in the AMC, and 3 upper GI surgeons and 3 HPB surgeons in the VUMC. After the merger, 5 upper GI surgeons (one surgeon quitted as an upper GI surgeon) and 7 HPB surgeons worked in the Amsterdam UMC. The AMC performed annually approximately 120 upper GI and 250 HPB surgical procedures and the VUmc approximately 70 upper GI and 150 HPB surgical procedures. The most important goal of the merger was: preservation and improvement of QoC for complex tertiary care, to excel in medical research, and to improve accessibility and efficiency [14,15]. The merger was executed as a phased process, in which clinical wards merge successively, to ensure preservation of high-quality and critical care. In so called waves, the joined departments were moved to their final location. For the upper GI group, the pre-merger period was July 27th, 2019, through January 26th, 2020, and the post-merger period was January 27th, 2020, through July 26th, 2020. For the HPB group, the pre-merger period was December 1st, 2020, through May 30th, 2021, and the post-merger period was May 31th, 2021, through November 30th, 2021.

Patient selection and definitions. Adult patients undergoing upper GI or HPB surgical procedures were included. Both elective and urgent procedures were eligible for this study. Upper GI procedures were defined as non-traumatic oncological procedures under general anesthesia performed on the stomach, esophagus, or both. The HPB procedures were defined as any non-traumatic oncological procedures under general anesthesia performed on the liver, pancreas, gallbladder or biliary ducts. The Age Adjusted Charlson Comorbidity Index (AAC) was used in assessing surgical outcomes weighed by comorbid conditions [16,17]. The AAC utilizes 19 pre-determined groups, weighted between one and six points and is adjusted for one point for every decade over 40 years of age with a maximum score of 6 points.

Outcomes. This study investigated short-term QoC, volume, and timeliness of care. Quality of care was assessed using mortality within 90 days postoperatively, hospital readmission rate within 90 days postoperatively, and incidence and severity of postoperative complications as outcome measures. A complication was defined as any deviation from the normal postoperative course [18]. The severity of the complications was assessed with the Comprehensive Complication (CC) index and the Clavien-Dindo classification (CD). The CD was used to categorize adverse events whereas the CC index was used to accurately represent the impact of multiple complications [18,19]. The CC index was calculated based on the registered and corrected CD data extracted from the database. The volume was determined scrutinizing the number of surgical procedures per working day in the pre-merger and post-merger phase. A working day was defined as every midweek day, with the exemptions of national public holidays in the Netherlands (in which no elective procedures are performed). Timeliness of care is defined as the system's capacity to provide care quickly after a need is recognized [20]. In this study it was assessed by investigating differences in waiting time of the surgical procedure in the pre-merger and post-merger phase. Waiting time was defined as interval between the moment a surgical procedure was scheduled and the day of surgery.

Analysis of the impact of the COVID-19 pandemic. The coronavirus disease 2019 pandemic broke out during the inclusion period of the upper GI group with extensive national measures from March 2020, resulting in a general surgical scale down. However, the board of directors of the Amsterdam UMC decided not to postpone surgical procedures of patients undergoing HPB or upper GI procedures for cancer in COVID-19 negative patients, since this oncological care was nationally considered as urgent. This was also recommended in a national guideline of the Dutch association of surgeons [21]. To analyze the impact on volume

of these measures, applied from the 12th of March 2020, patients undergoing an upper GI surgical procedure before March 12th were compared with patients undergoing an upper GI from March 12th.

Statistical analysis. Statistical Package for the Social Sciences, version 26, was used for analyses. Continuous variables were reported as mean with a standard deviation or median with an interquartile range (IQR) in variables with a skewed distribution. Dichotomous variables were noted as number and percentage. Patients in the pre-merger period were compared with the post-merger period. Within the pre-merger period, patient characteristics of patients who underwent their surgical procedure in the AMC were compared with those in the VUmc. Differences between patient characteristics before and after the merger were compared using Pearson chi-square and Fisher's exact test (in case of small cell counts) in dichotomous variables and a student's *t*-test or Mann-Whitney *U* test (skew distribution) in continuous variables. The outcomes were assessed utilizing univariate- and multivariate analyses. Multivariate regression analyses were utilized to adjust for confounders with an impact of 10% or more on the unstandardized beta. To assess the relation between the two waves, odds Ratio (OR), mean differences (MD), and 95% confidence interval (95% CI) were used. A p-value <0.05 was considered statistically significant.

Results

Patient characteristics are shown in Tables 1 and 2. Between July 27th 2019 and November 30th 2021, a total of 631 patients were included: 195 patients (30.9%) underwent an upper GI procedure and 436 (69.1%) a HPB procedure. The pre-wave group contained 320 patients (50.7%) and the post-wave 311 (49.3%). In the pre-merger period, 62 and 135 patients in the AMC, and 35 and 88 in the VUmc underwent an upper GI or HPB surgical procedure, respectively. The median age was 68 years (IQR: 61–74) in the upper GI and 66 (IQR: 57–73) in the HPB group. The majority of patients was male (71.0% vs 68.9%; p = 0.719 in the upper GI group, 54.3% vs 55.5%; p = 0.243 in the HPB group). In patients undergoing upper GI surgery, esophagectomies constituted the largest proportion of procedures (n = 100, 51.3%). In the HPB group pancreatoduodenectomies were performed most often (n = 142; 32.6%).

Upper GI outcomes. The proportion of patients undergoing upper GI surgery who developed a postoperative complication in the pre-merger and post-merger phase was comparable (58.8% vs 58.2%; OR: 0.88 [95% CI: 0.58–1.88]; p = 0.880), with a median number of 2 complications in both the pre-merger and post-merger period in patients with a complicated postoperative course (MD: 0.18 [95% CI: −0.59–0.95]; p = 0.643). The median CC index score was 33.5 (IQR: 20.9–50.9) in the pre-merger and 33.7 in the post-merger (IQR: 20.9–46.0) group (MD: −2.54 [95% CI: 1.-11.21–6.12]; p = 0.562). A total of 37 patients (34.0%) in the pre-merger and 29 (28.6%) in the post-merger group had a CD of 3 or higher (OR: 0.87 [95% CI: 0.47–1.61]; p = 0.661). Mortality (2.1% vs 1.0%), readmission within 90 days (13.4% vs 13.3%; p = 0.922), and median length of stay (8 vs 9, p = 0.915) were all not statistically significant (Table 3).

Table 1
Patients characteristics, surgery characteristics, and patients history in the upper GI group.

	Prior to merge (n = 97)				After merge (n = 98)	
	AMC (n = 62)	VUmc (n = 35)	P-value	Total pre-merger		P-value
Elective procedures				93 (95.9%)	97 (99.0%)	0.170
Number of working days	[a]	[a]		126	125	
Surgical procedures per working day [median, IQR]	[a]	[a]		1 [0–2]	1 [0–2]	0.893
Waiting time for elective surgery in days	82	76	0.561	80	83	0.734
[IQR, median]	[31–125]	[25–97]		[28–124]	[16–105]	
		Patient characteristics				
Age in years	68	69	0.550	68	69	0.493
[median, IQR]	[63–74]	[61–76]		[62–75]	[64–75]	
Sex						
Male	60 (67.4%)	33 (78.6%)	0.189	72 (74.2%)	70 (71.4%)	0.661
Female	23 (32.6%)	9 (21.4%)		25 (25.8%)	28 (28.6%)	
BMI in kg/m^2	25	25	0.400	25	24	0.839
[median, IQR]	[23–28]	[23–28]		[23–28]	[23–29]	
		Surgery characteristics				
Site of surgery			0.710			0.352
Gastric	29 (46.7%)	14 (40.0%)		43 (44.3%)	38 (38.8%)	
Esophageal	33 (53.2%)	21 (60.0%)		54 (55.6%)	60 (61.2%)	
Surgical procedure			0.006			0.125
Esophagectomy	28 (45.2%)	21 (60.0%)		49 (50.1%)	51 (52.0%)	
McKeown	5 (17.9%)	8 (38.1%)		13 (26.5%)	7 (13.7%)	
Ivor Lewis	18 (64.2%)	9 (42.8%)		27 (55.1%)	38 (74.5%)	
Other	5 (17.9%)	4 (19.0%)		9 (18.4%)	6 (11.8%)	
(Sub)total gastrectomy	19 (30.1%)	12 (34.2%)		31 (32.0%)	32 (32.7%)	
Other	15 (24.2%)	2 (2.1%)		17 (17.5%)	15 (15.3%)	
		Patient history				
AAC [median, IQR]	4 [3–6]	4 [3–6]		4 [3–6]	4 [3–6]	0.502
0–1	4 (6.5%)	1 (2.9%)		5 (5.2%)	6 (6.1%)	
2–3	22 (35.5%)	2 (5.7%)		24 (24.7%)	16 (16.3%)	
4–5	25 (40.3%)	16 (45.7%)		41 (42.3%)	40 (40.8%)	
≥6	11 (17.7%)	16 (45.7%)		27 (27.8%)	36 (36.7%)	
Abdominal or thoracic surgery in medical history	25 (40.3%)	12 (34.4%)	0.557	37 (38.1%)	40 (40.8%)	0.986

GI; Gastro-Intestinal surgery, AMC; Academic Medical Center, VUmc; Free University Medical Center, IQR; interquartile range, BMI; body mass index, AAC; Age adjusted Charlson Comorbidity index.
[a] Not applicable.

Table 2
Patients characteristics, surgery characteristics, and patients history in the HPB group.

	Prior to the merge (n = 223)				After merge (n = 213)	
	AMC (n = 135)	VUmc (n = 88)	P-value	Total pre-merge		P-value
Elective procedures	122 (90.4%)	77 (87.5%)	0.499	199 (89.2%)	194 (92.8%)	0.194
Number of working day	*	*		122	131	
Surgical procedures per working day [median, IQR]	*	*		2 [1–2]	1 [1–2]	0.278
Waiting time for elective surgery in days [IQR, median]	22 [12–39]	22 [13−33]	0.559	22 [12–36]	24 [13–43]	0.163
	Patients' characteristics					
Age in years [median, IQR]	65 [57–72]	68 [58–77]	0.182	64 [56–72]	66 [57–73]	0.243
Sex						
Male	83 (61.5%)	38 (43.2%)	0.007	121 (54.3%)	116 (55.5%)	0.736
Female	52 (38.5%)	50 (56.8%)		102 (45.7%)	97 (44.5%)	0.719
BMI in kg/m^2 [median, IQR]	25.4 [22.9–29.0]	25.9 [22.9–28.7]	0.898	25.6 [23.0–28.7]	25.0 [22.5–28.0]	0.226
	Surgery characteristics					
Site of surgery			0.347			0.205
Hepatic	32 (23.7%)	23 (26.1%)		55 (24.7%)	71 (33.3%)	
Pancreatic	68 (50.4%)	34 (38.6%)		102 (45.7%)	84 (39.4%)	
Biliary	29 (21.5%)	26 (29.5%)		55 (24.7%)	51 (23.9%)	
Other	6 (4.4%)	5 (5.7%)		11 (4.9%)	7 (3.3%)	
Surgical procedure			0.306			0.591
Pancreatoduodenectomy	46 (34.1%)	29 (33.0%)		75 (33.6%)	67 (31.5%)	
Partial hepatectomy	27 (20%)	19 (21.6%)		46 (20.6%)	55 (25.8%)	
Distal pancreatectomy	19 (14.1%)	5 (5.7%)		24 (10.8%)	16 (7.5%)	
Cholecystectomy	27 (20%)	24 (27.3%)		51 (22.9%)	47 (22.1%)	
Other	16 (11.9%)	11 9 (12.5%)		27 (12.1%)	28 (13.1%)	
	Patient history					
AAC [median, IQR]	4 [3–6]	4 [3–6]	0.942	4 [3–6]	4 [3–5]	0.458
0–1	10 (7.4%)	8 (9.1%)		15 (11.5%)	13 (10.9%)	
2–3	33 (24.4%)	19 (21.4%)		32 (24.4%)	22 (18.5%)	
4–5	58 (43%)	38 (43.2%)		49 (37.4%)	42 (35.3%)	
≥6	34 (25.2%)	23 (26.1%)		35 (26.7%)	42 (35.3%)	
Abdominal or thoracic surgery in medical history	44 (32.6%)	40 (45.5%)	0.053	84 (37.7%)	80 (37.6%)	0.981

HPB; hepato- biliary-pancreatic, AMC; Academic Medical Center, VUmc; Free University Medical Center, IQR; Interquartile range, BMI; body mass index, AAC; Age adjusted Charlson Comorbidity index.

HPB outcomes. The proportion of patients undergoing HPB surgery with postoperative complications in the pre-merger and post-merger phase was comparable (48.4% vs 45.1%; OR: 0.90 [95% CI: 0.59–1.36]; p = 0.606), with a median number of complications per patient of 2 in both phases (MD: 0.33 [95% CI: −0.08–0.73]; $p = 0.113$). The median CC index score was 26.2 (IQR: 20.9–40.7) in the pre-merger and 33.5 (IQR: 26.2–44.9) in the post-merger group (MD: 1.53 [95% CI −2.21–5.28]; p = 0.421). A total of 53 patients (23.8%) in the pre-merger and 64 (30.0%) in the post-merger group had a CD of 3 or higher (OR: 1.44 [95% CI: 0.94–2.22]; p = 0.095). Mortality (0.4% vs 0%; p = 0.995), readmission within 90 days (11.7% vs 16.9%; p = 0.119), and median length of stay (7 vs 6, p = 0.905) were all statistically not significant (Table 4).

Impact of the hospital merger on number of surgical procedures and timeliness of care. As shown in Table 1 and Fig. 1, the median number of upper GI procedures per working day was 1 in both the pre-merger (IQR: 0–2) and the post-merger (IQR: 0–2) phase (p = 0.595). The median waiting time for elective surgery was 80 days in the pre-merger period and 83 in the post-merger phase (p = 0.893). As shown in Table 2 and Fig. 2, the number of surgical procedures per working day in the HPB group was 2 in the pre-merger phase (IQR: 1–2) and 1 in the post-merger (IQR: 1–2) phase. This difference, however, was not statistically significant (p = 0.278). The median waiting time for elective surgery was 22 days in the pre-merger period and 24 in the post-merger phase (p = 0.163).

Impact of the COVID-19 pandemic. There was no difference in the average number of surgical upper GI procedures during the COVID-19 pandemic. The median number of performed upper GI procedures per working day was 1 before (IQR: 0–1) and 1 (IQR: 0–2) during the pandemic (p = 0.331) (Table 5).

Discussion

The aim of this study was to evaluate the short-term effect of a merger of two university hospitals on quality of surgical care, volume, and timeliness of care in patients undergoing an oncological upper GI or HPB surgical procedure. There were no signs of short-term deterioration in the evaluated quality metrics, volume and timeliness of care after the merger. This suggests that, a hospital merger of two university hospitals can be performed without jeopardizing patient safety in the short-term of two highly-complex surgical disciplines, while profiting from the benefits of the merger. The putative long-term benefits hospital mergers in general are reduced duplication services, beneficial synergistic impacts, and increased market powers [22]. The benefits of this specific merger are, as mentioned in the predetermined goals, centralization of highly specialized tertiary care and enhancement of medical research [14,15].

Some factors influencing QoC should be addressed in the light of these findings. Firstly, some nurses and paramedics remained at their initial location, according to their own individual preference. This may have led to a loss in expertise and subsequently to QoC, since many of these nurses and paramedics were experienced in the postoperative management of both upper GI and/or HPB patients. It is therefore possible that the QoC will improve in the near future, since new expertise will be gained over time. Secondly, the geographical distance between the

Table 3
Postoperative outcomes of patients undergoing upper GI surgery.

	Prior to merge (n = 97)			After merge (n = 98)			
						Multivariate	
	AMC (n = 62)	VUmc (n = 35)	P-value	Total Pre-merge		OR (95% CI)	P-value
Patients with complication	33 (53.2%)	24 (68.6%)	0.140	57 (58.8%)	57 (58.2%)	1.05 (0.58–1.88)	0.880[a]
CD ≥ 3	19 (30.6%)	13 (37.1%)	0.513	33 (34.0%)	28 (28.6%)	0.87 (0.47–1.61)	0.661[b]
Mortality	2 (3.2%)	0		2 (2.1%)	1 (1.0%)	[g]	[g]
Readmission[h]	7 (11.3%)	6 (17.1%)	0.416	13 (13.4%)	13 (13.3%)	0.96 (0.412–2.23)	0.922[c]

	Prior to merge (n = 97)			After merge (n = 98)			
						Multivariate	
	AMC (n = 62)	VUmc (n = 35)	P-value	Total Pre-merge		MD (95% CI)	P-value
Number of complications[i]	2 [1–5]	2 [1–3]	0.548	2 [1–3]	2 [1–4]	0.18 (−0.59–0.95)	0.643[d]
CC index[i]	33.5 [20.9–53.0]	33.7 [16.5–68.9]	0.689	33.5 [20.9–51.7]	29.6 [20.9–46.5]	−2.54 (−11.21–6.12)	0.562[e]
Length of stay	9 [5–14]	7 [6–10]	0.440	8 [6–14]	9 [6–14]	−0.08 (−1.52–1.37)	0.915[f]

GI; gastro-intestinal, OR; odds ratio, 95% CI; 95% confidence interval, CD; Clavien-Dindo, CC; comprehensive complication, MD; mean Difference.
[a] Adjusted for: BMI, AAC.
[b] Adjusted for: BMI.
[c] Adjusted for: age, BMI.
[d] Adjusted for: BMI, gender, elective procedure, type of surgery, AAC.
[e] Adjusted for: age, BMI.
[f] Adjusted for: no confounders found.
[g] Not applicable.
[h] Readmission within 90 days postoperatively.
[i] In patients with at least one postoperative complication.

merging hospitals might have played a facilitating role in the current merger. Several studies showed negative associations between the distance to the nearest hospital and QoC [23,24]. The travel time between both hospitals both with car and public transport is approximately 20–30 min. In this merger it is unlikely that geographical distance influenced the post-merger QoC. The findings of the current study are in contrast with two studies, that described temporary deterioration in QoC in terms of increased waiting times, decreased quantity of patient contacts

Table 4
Postoperative outcomes of patients undergoing HPB surgery.

	Prior to merge (n = 223)				After merge (n = 213)		
						Multivariate	
	AMC (n = 135)	VUmc (n = 88)	P- value	Total Pre-merger		OR (95% CI)	P-value
Patients with complication	61 (45.2%)	47 (53.4%)	0.230	108 (48.4%)	96 (45.1%)	0.90 (0.59–1.36)	0.606[a]
CD ≥ 3	34 (25.2%)	19 (21.6%)	0.538	53 (23.8%)	64 (30.0%)	1.44 (0.94–2.22)	0.095[b]
Mortality	1 (0.7%)	0	0.418	1 (0.4%)	0	[g]	[g]
Readmission[g]	17 (12.6%)	9 (10.2%)	0.591	26 (11.7%)	36 (16.9%)	1.54 (0.90–2.65)	0.119[c]

	Prior to merge (n = 223)				After merge (n = 213)		
						Multivariate	
	AMC (n = 135)	VUmc (n = 88)	P- value	Pre-wave Median [IQR]	Post-wave Median [IQR]	MD (95% CI)	P-value
Number of complications[h]	2 [1–4]	2 [1–4]	0.676	2 [1–4]	2 [1–5]	0.33 (−0.08–0.73)	0.113[d]
CC index[h]	29.5 [20.9–42.6]	22.6 [8.7–33.7]	0.584	26.2 [20.9–40.7]	33.5 [26.2–44.9]	1.53 (−2.21–5.28)	0.421[e]
Length of stay	7 [4–11]	6 [4–11]	0.672	7 [4–10]	6 [3—10]	−0.12 (−2.10–1.87)	0.905[f]

HPB; hepato- biliary-pancreatic, OR; odds ratio, 95% CI; 95% confidence interval, CD; Clavien-Dindo, MD; mean Difference, CC; comprehensive complication.
[a] Adjusted for: age, elective procedure, type of surgery.
[b] Adjusted for: age.
[c] Adjusted for: no confounders found.
[d] Adjusted for: age.
[e] Adjusted for: age, elective procedure.
[f] Adjusted for: age, BMI, elective procedure, site of surgery, type of surgery.
[g] Not applicable.
[h] In patients with at least one postoperative complications.

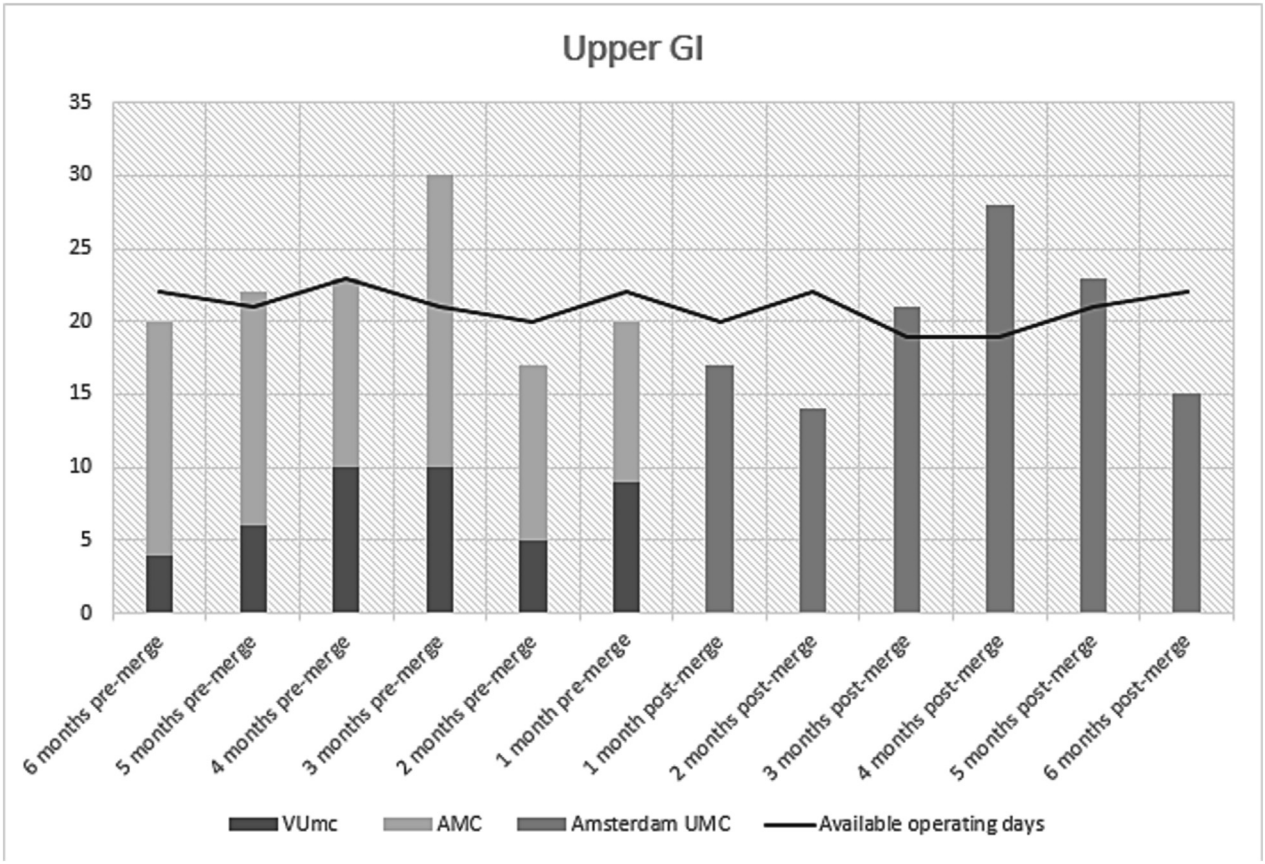

Fig. 1. Number of surgical procedures performed in the upper GI group
This figure shows the number of procedures in patients undergoing upper GI surgery in the six months before the merger on 27th June 2020, in the AMC (light colored bar, n = 62) and VUmc hospital (dark colored bar, n = 35) and in the six after the merger in the Amsterdam UMC (grey bar, n = 98). The black line displays the number of working days in that month. GI; gastro-intestinal, AMC; Academic Medical Center, VUmc; Free University Medical Center, Amsterdam UMC; Amsterdam University Medical Center.

and increased mortality rates, after university hospital mergers [11,14]. Arguably, the meticulous preparations, such as the foundation of steering groups assisting in the integration, harmonization, and lateralization processes, prior to the merger described in this study must have played an important role in the preservation of QoC.

Yet, the impact of a hospital merger is more than just the effect on QoC and a myriad of caveats should be borne in mind. The rub lies in alignment of the pre- and post-merger culture. The organizational culture of the two hospitals and the communication with employees are found to be dominant factors in determining success or failure of a merger, since it has a very large psychological effect on individual healthcare providers [25]. Next to this, the larger the cultural differences, the more arduous the integration. Gathering and evaluating pre-merger cultural data is essential to provide insight in differences and to formulate a post-merger culture [26]. The aforementioned steering group were aware of these threats and were designed to tackle them during the whole process. Finally, the meticulous preparations prior to the merger potentially raised the awareness to provide top quality health care. In the long-term this awareness could drop and lead to a decrease in quality of care [27]. A future study is needed to elaborate on the effect of such merger on long-term quality of care.

This is the first study investigating the short-term impact of a merger of two highly specialized surgical departments. However, some limitations should be addressed. The number of included patients was relatively small, reducing the power of the study and increasing the margin of error. Especially in rare events (e.g., patient death) it is usually difficult to assess differences. Patients compared in the pre-merger and post-merger phase underwent a surgical procedure in contrasting seasons. There is some contradictory evidence of the effect of seasonality on postoperative outcomes. Spencer et al. provided in a recently published systematic review tentative evidence for an increased risk of postoperative complications in the summer [28]. This putative effect of seasonality could have influenced the findings of this study. However, this effect is small and unlikely to significantly influence the findings of our relatively small cohort. Then, the COVID-19 pandemic broke out during the post-merger period of the upper GI cohort. This could have led to changes in the outcomes. However, although extensive measures within the hospital were applied, there was no decrease in number of upper GI procedures or increase in morbidity during the COVID-19 pandemic in this study. The national recommendations were followed and were in alignment with the results of Borgstein et al., who showed no increase in morbidity in four European tertiary esophageal cancer referral centers during the first wave of the COVID-19 pandemic [29]. Due to insufficient data available, no analyzes could be performed on patient satisfaction or nurse satisfaction score therefore patient and nursing experience and satisfaction were not regarded in this study. Linking short-term postoperative outcomes to patient experience data can reveal ways to optimize care [30]. Finally, the number of surgical procedures per day also depends on local policy decisions. It could be that OR time was divided unequal between different specialisms pre- and post-merger.

Conclusion

The merger of two Dutch university hospitals did not show any sign of deterioration in the evaluated short-term quality metrics, volume or timeliness for upper GI and HPB surgery. This suggest that a hospital merger of two university hospitals can be performed safely, and while

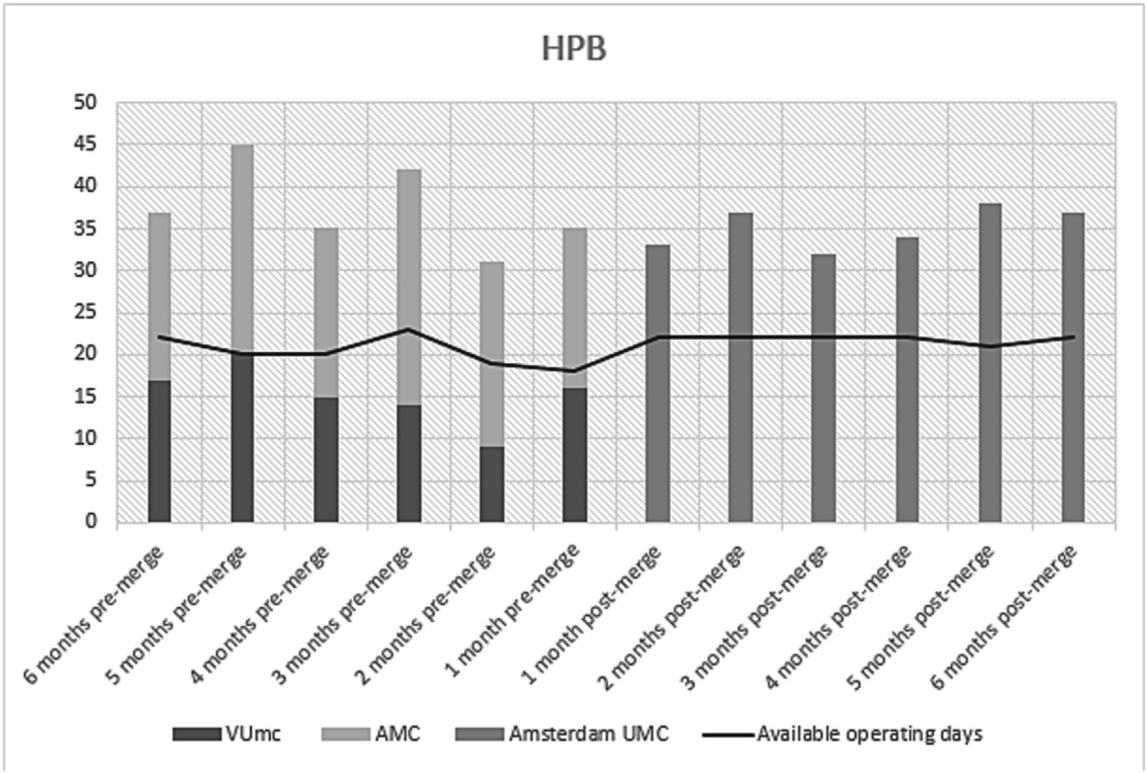

Fig. 2. Number of procedures performed in the HPB group
This figure shows the number of procedures in patients undergoing HPB surgery in the six months before the merger on 30th June 2021, in the AMC (light colored bar, n = 135) and VUmc hospital (dark colored bar, n = 88) and in the six after the merger in the Amsterdam UMC (grey bar, n = 213). The black line displays the number of working days in that month. HPB; hepato-biliary-pancreatic, VUmc; Vrije Universiteit Medisch Centrum, AMC; Academisch Medisch Centrum, Amsterdam UMC; Amsterdam University Medical Center.

benefitting from centralization of highly specialized care and enhancement of medical research. Future studies should investigate the long-term effect of the merger on quality of care.

Statement

This article has not been previously published or submitted elsewhere for publication and will not be sent to another journal until a decision is made concerning publication by International journal of integrated care.

Registration

Not registered.

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Ethics approval

This work was approved by the ethical committee of the Amsterdam UMC.

CRediT authorship contribution statement

E.W. Ingwersen: conceptualization, methodology, investigation, formal analysis, writing – original draft, p.
W.T. Stam: conceptualization, methodology, investigation, formal analysis.
L.J. van Kesteren: formal analysis, writing – original draft.
I.J.A. Wissink: methodology, writing – review & editing.
M.I. van Berge Henegouwen: data curation, writing – review & editing.
M.G. Besselink: data curation, writing – review & editing.
O.R. Busch: data curation, writing – review & editing.
J.I. Erdmann: data curation, writing – review & editing.
W.J. Eshuis: data curation, writing – review & editing.
S.S. Gisbertz: data curation, writing – review & editing.

Table 5
Number of patients undergoing upper GI surgery during the COVID-19 pandemic.

	Before the COVID-19 pandemic (n = 121)	During the COVID-19 pandemic (n = 74)	Total (n = 195)	P-value
Elective procedures	117 (96.7%)	73 (98.6%)	190 (97.4%)	0.873
Working days	161	90	251	
Elective procedures per working day [median, IQR]	1 [0–1]	1 [0–2]	1 [0–2]	0.331

This table compares the number of procedures per working day before en during the COVID-19 pandemic, with 12 March 2020 as reference date.
GI; gastro-intestinal, COVID-19; coronavirus disease 2019, IQR; interquartile range.

G. Kazemier: data curation, writing – review & editing.
D.L. van der Peet: data curation, writing – review & editing.
R.J. Swijnenburg: data curation, writing – review & editing.
B. Zonderhuis: data curation, writing – review & editing.
F. Daams: data curation, writing – review & editing, supervision.

Data availability statement

the data that support the findings are available from the corresponding author upon reasonable request.

Declaration of competing interest

M.I. van Berge Henegouwen has a consultant role with Mylan, Johnson and Johnson, Alesi Surgical, B. Braun, and Medtronic. Research funding was received from Stryker. M.I. van Berge Henegouwen reports grants from Olympus and Stryker and personal fees from Johnson and Johnson, Medtronic, Mylan, and Alesi Surgical. All fees paid to institutions outside the submitted work. All the other authors have no related conflict of interest to declare.

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