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ORIGINAL ARTICLE

Failure to rescue in patients with distal pancreatectomy: a nationwide analysis of 10,632 patients

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Abstract

Background: FTR appears as a major cause of postoperative mortality (POM). Hospital volume has an impact on FTR in pancreatic surgery but no study has investigated this relationship more specifically in DP.

Methods: We analysed patients with DP between 2009 and 2018 through a nationwide database. FTR definition was mortality among patients who experiment major complications. The cutoff between high and low volume centers was 20 pancreatectomies per year.

Results: Some 10,632 patients underwent DP, 5048 (47.5%) were operated in 602 (95.4%) low volume centers and 5584 (52.5%) in 29 (4.6%) high volume centers. Overall FTR occurred in 11.2% of patients and was significantly reduced in high volume centers compared to low volume centers (10.2% vs 12.5%, $p = 0.047$). In multivariate analysis, surgery in a high volume center was a protective factor for POM (OR = 0.570, CI95% [0.505–0.643], $p < 0.001$) and also for FTR (OR = 0.550, CI95% [0.486–0.630], $p < 0.001$).

Conclusion: Hospital volume has a positive impact on FTR in DP. Patients with higher risk of FTR are men, with high modified Charlson comorbidity index, malignant conditions and open procedures.

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Introduction

In recent years, the number of patients diagnosed with lesions of the pancreas requiring surgical resection has increased.[1] Even in modern series, these resections are challenging procedures, often related with high postoperative morbidity and mortality (respectively 30% and 7%).[2–4] In pancreatic surgery, major complications have negative impacts on postoperative outcomes including long term survival, quality of life and costs, even in the era of neoadjuvant chemotherapy.[5–8] Distal pancreatectomy (DP) is associated with lower mortality than pancreaticoduodenectomy but it still has a significant postoperative morbidity.[9–11] Authors and national healthcare societies promote centralization of all pancreatic resections since nationwide studies reported in high volume centers a significant decrease of postoperative morbidity and mortality, length of stay and total costs, [12–17] associated with better resection rates and survival.[18] There is now a consensus that variations in postoperative mortality (POM) are due to failure to rescue (FTR), meaning the number of deaths among patients experimenting major post-operative complications.[19–21] It represents the ability for a center to manage post-operative complications and to avoid death. After recent reports, FTR appears to be a relevant indicator for quality of care after surgical procedures related to postoperative morbidity and its management.[22–24] (Table 1).

A retrospective study[25] and a recent nationwide study[4] reported that FTR after pancreatectomy is high and directly correlated to hospital volume, highlighting variability in the management of postoperative complications. According to the authors, FTR after pancreatectomy appears to be significantly lower in high volume centers with more than 20 pancreatic resections per years. In recent observational studies, minimally

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invasive distal pancreatectomy (MIDP) has been reported, for both malignant and benign diseases, to be safe, to have advantages compared with open distal pancreatectomy (ODP) in term of blood loss, postoperative pain, cosmetic results, duration of in-hospital stay, postoperative recovery and oncological outcomes.[26–30] A recent multicenter patient blinded randomized controlled trial[31] showed that MIDP reduces time to functional recovery compared with ODP and was associated with less delayed gastric emptying and better quality of life without increasing costs.

The primary objective of this study was to determine if hospital volume has an impact on FTR after DP for both malignant and benign lesions, using the French national administrative prospective database. The secondary objective was to determine if MIDP and patients' characteristics have independent impacts on FTR.

Patients and methods

PMSI database

Data were extracted from the French national administrative prospective database for hospital care (PMSI: Programme de Médicalisation des Systèmes d'Information) containing all discharge reports from both private and public hospitals in France.[10] Discharge abstracts included all patient demographics, diagnosis from the International Classification of Diseases 10th edition (ICD 10-CM[32]) and therapeutic procedures (from the Classification Commune des Actes Médicaux). This database was provided with chained anonymized patient information from the years 2009–2018. The reliability and validity of PMSI data have already been assessed.[33–36] All data were completely anonymous and individual consent was not required. Ethics approval for the use of this database was

Table 1 Patient and hospital characteristics

Total: 10,632 patients		**Centers <20 resections** N = 5048 (47.5%)	**Centers ≥20 resections** N = 5584 (52.5%)	**P**
Number of hospitals		602 (95.4%)	29 (4.6%)	<0.001
Teaching status	Yes	469 (9.3%)	5054 (90.7%)	<0,001
	No	4579 (89.6%)	530 (10.4%)	
Number of patients	2009–2011	1382 (27.4%)	1522 (27.3%)	0.974
	2012–2014	1544 (30.6%)	1719 (30.8%)	
	2015–2018	1583 (42.0%)	1788 (41.9%)	
Sex	Male	2316 (45.9%)	2554 (45.7%)	0.884
	Female	2732 (54.1%)	3030 (54.3%)	
Age	Mean	64.3	61.7	<0.001
	95% CI	[64.1; 64.5]	[61.5; 62.0]	
ChCIm	0–2	2980 (59.0%)	3542 (63.4%)	<0.001
	3	744 (14.7%)	809 (14.5%)	
	≥4	1324 (26.3%)	1233 (22.1%)	
Chronic comorbidities	Pulmonary disease	712 (14.1%)	670 (12.0%)	0.001
	Myocardial infarction	247 (4.9%)	266 (4.8%)	0.756
	Chronic heart failure	145 (2.9%)	138 (2.5%)	0.199
	Peripheral vascular disease	118 (2.3%)	147 (2.6%)	0.330
	Cerebrovascular disease	28 (0.6%)	22 (0.4%)	0.227
	Liver disease	71 (1.4%)	130 (2.3%)	<0.001
	Chronic renal disease	92 (1.8%)	131 (2.4%)	0.060
	Metabolic disease	1290 (25.6%)	1343 (24.1%)	0.073
	Malnutrition	741 (14.7%)	985 (17.6%)	<0.001
	Obesity	456 (8.7%)	474 (8.5%)	0.321
Indication	Benign disease	1557 (30.8%)	1908 (34.2%)	<0,001
	Malignant disease	3491 (69.2%)	3676 (65.8%)	
Procedure	Open	3945 (78.2%)	4245 (76.0%)	0.009
	Laparoscopic	1103 (21.8%)	1339 (24.0%)	

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obtained from the National Commission for Data Protection (CNIL No 1576793), and this study was in accordance with the tenets of the declaration of Helsinki.

Patients

All patients discharged between January 1st 2009 and December 31st 2018, with diagnosis in the 10th revision of the International Classification of Diseases (ICD10) of benign or malignant tumor of the pancreas were selected. The Common Classification of Medical Procedures (CCAM) was used to define the interventions, including distal pancreatectomy (DP), distal pancreato-splenectomy (DPS) by open and minimally invasive surgery. Patients with pancreaticoduodenectomy, central pancreatectomy and total pancreatectomy were excluded as well as patients undergoing vascular or other organs extended resections. Population characteristics included age, sex, use of MIDP, number of pancreatic resections of each center and its teaching status. From the ICD10, we extracted data regarding comorbidities such as: pulmonary disease, myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, liver disease, chronic renal disease, metabolic disease, anemia, denutrition, obesity. We used a validated Charlson comorbidity score (ChCI) for patient comorbidities with the ICD-10-CM diagnosis: patients were divided into 3 groups according to ChCl 0–2, 3, $\geq$ 4. For the FTR multivariate analysis, modified ChCI with age was calculated. We used the same hospital volume cut-off as the last nationwide analysis about FTR in pancreatectomy by Elamrani et al.[4] This critical cut off was 20 resections per year and hospitals were divided into low (<20 resections/year) and high volume centers ($\geq$20 resections/year).

Postoperative mortality, major complications and failure to rescue

POM was defined as 90-day or in-hospital mortality in the surgery ward or in the intensive care unit (ICU). Postoperative complications were identified using ICD-10-CM codes. Major postoperative complications were all medical and surgical complications with Dindo and Clavien score >2: cardiac, digestive, shock, hemorrhage, neurologic, sepsis, pulmonary, renal, thromboembolic. Specific complications of pancreatic surgery such as intra-abdominal hemorrhage, portal vein thrombosis, intra-abdominal abscess, pancreatic fistula, delayed gastric emptying and procedures related to those complications: relaparotomy, radiological, surgical or endoscopic procedures were also considered as major complications as they occurred postoperatively, with a Dindo and Clavien score >2. All other complications were recorded as minor complications.

Failure to rescue, as the primary outcome, was defined as the number of deaths among patients with at least one major postoperative complication within the 90 days after surgery. It represents the ability for a center to manage post-operative complications and to avoid death.

Statistical analysis

Binary or categorical variables were expressed as numbers and percentages, continuous variables as means and standard deviations. To determine the independent factors of major complications, POM and FTR, we performed univariate analyses with chi-squared tests for binary and categorical variables and t-tests for continuous variables.

We used a conventional logistic regression to estimate the relationship between patient preoperative characteristics, hospitals, the period and the FTR classified in two classes (yes or no). Variables with a level of significance of $\leq$0.1 in univariate analysis were included in the multivariate analysis by means of logistic regression. Continuous or ranked variables were tested to ensure conformity with the linear gradient by using the likelihood ratio chi-squared statistic. Interaction effects were sought for all of the variables included in the model. All models were constructed by using backward stepwise variable selection. A step-down variable selection using Akaike's information criterion was used as a stopping rule. The purpose of the regression analysis, age and modified CCI score were categorized. The other variables were binary. The area under the receiver operating characteristic (ROC) curve was used to measure the discriminatory ability of the model. The reliability of the model was assessed with the Hosmer–Lemeshow goodness-of-fit test.

Calculations were performed with STATA 14 statistical software (StataCorp, College Station, Tex).

Results

Patient characteristics according to hospital volume (Table 1)

Between 2009 and 2018, 10,632 patients underwent DP in 631 centers. Among this overall population, 54.2% were men, mean age was 63.0 years, 61.3% had a ChCI between 0 and 2, comorbidities were metabolic diseases (24.8%) and malnutrition (16.2%). The indication was a malignant disease in 67.4%, the procedure was performed by ODP in 77.0%, in a teaching status center in 52.0%. A total of 5048 (47.5%) patients were operated in 602 (95.4%) low volume centers and 5584 (52.5%) patients in 29 (4.6%) high volume centers. The repartition of these patients was the same between the two kinds of centers over the 3 studied time periods 2009–2011, 2012–2014, 2015–2018. Patients were almost 3 years older in low volume centers (64.3 years vs 61.7 years, $p < 0.001$) and had more comorbidities (CCI 0–2: 59% vs 63%, CCI $\geq$ 4: 26.3% vs 22.1%, $p < 0.001$). High volume centers were more likely teaching hospitals (89.9%, $p < 0.001$) and performed more MIDP (24.0% vs 21.8%, $p = 0.009$).

Patient outcomes (Table 2)

Thirty percent of patients had major post-operative complications. Major complications were more likely treated in high volume centers with a teaching status than in low volume centers (30.6% vs 28.6%, $p < 0.001$). Major complications occurred

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Table 2 90 Days complication rates across hospital and patient characteristics

		No Complication	Minor Complication	Major Complication	p
		N = 4514 (42.5%)	N = 2965 (27.9%)	N = 3153 (29.6%)	
Hospital volume	<20/y	2258 (44.7%)	1347 (26.7%)	1443 (28.6%)	<0.001
	≥20/y	2256 (40.4%)	1618 (29.0%)	1710 (30.6%)	
Teaching status	Yes	2202 (39.9%)	1617 (29.3%)	1704 (30.8%)	<0.001
	No	2312 (45.2%)	1348 (26.4%)	1449 (28.4%)	
Periode	2009–2011	1468 (55.5%)	696 (24.0%)	740 (25.5%)	<0.001
	2012–2014	1371 (42.0%)	876 (26.9%)	1016 (31.1)	
	2015–2018	1675 (37.5%)	1393 (31.2%)	1397 (31.3%)	
Sex	Male	1754 (36.0%)	1362 (28.0%)	1754 (36.0%)	<0.001
	Female	2760 (47.9%)	1603 (27.8%)	1399 (24.3%)	
Age	Mean	58.5	61.6	62.5	<0.001
	<50 yrs			502 (23.3%)	<0.001
	50–59 yrs			621 (28.4%)	
	60–69 yrs			959 (30.8%)	
	70–79 yrs			866 (33.8%)	
	≥80 yrs			205 (33.1%)	
ChCI	0–2	3198 (49.0%)	1867 (28.7%)	1457 (22,3%)	<0,001
	3	548 (35.3%)	459 (29.6%)	546 (35.1%)	
	≥4	768 (30.0%)	639 (25.0%)	1150 (45.0%)	
Chronic comorbidities	Pulmonary disease	214 (15.5%)	379 (27.4%)	789 (57.1%)	<0.001
	Myocardial infarction	127 (24.8%)	144 (28.1%)	242 (47.1%)	<0.001
	Chronic heart failure	38 (13.4%)	76 (26.9%)	169 (59.7%)	<0.001
	Peripheral vascular disease	60 (22.6%)	76 (28.7%)	129 (48.7%)	<0.001
	Cerebrovascular disease	7 (14.0%)	8 (16.0%)	35 (70.0%)	<0.001
	Liver disease	19 (9.5%)	42 (20.9%)	140 (69.6%)	<0.001
	Chronic renal disease	41 (18.4%)	54 (24.2%)	128 (57.4%)	<0.001
	Metabolic disease	887 (33.7%)	779 (29.6%)	967 (36.7%)	<0.001
	Malnutrition	0 (0.0%)	765 (44.3%)	961 (55.7%)	<0.001
	Obesity	606 (29.5%)	514 (25.0%)	937 (45.5%)	<0.001
Indication	Benign disease	1657 (47.8%)	1046 (30.2%)	762 (22.0%)	<0.001
	Malignant disease	2857 (39.9%)	1919 (26.8)	2391 (33.3%)	
Procedure	Open	3280 (40.1%)	2157 (26.3%)	2753 (33.6%)	<0.001
	Laparoscopic	1234 (50.5%)	808 (33.1%)	400 (16.4%)	

more frequently in men (36.0% vs 24.3%, $p < 0.001$), with ChCI ≥ 4 (45.0%, $p < 0.001$), with chronic comorbidities and a malignant disease (33.3% vs 22.0%, $p < 0.001$). Obese patients were also more likely to experiment major complications (45.5% vs 41.1%, $p < 0.001$).MIDP was associated with lower major complications (16.4% vs 33.6%, $p < 0.001$).

Patients without postoperative complication were younger (58.5 years vs 62.5 years, $p < 0.001$), had fewer comorbidities (49.0% ChCI ≤ 2, $p < 0.001$), had more likely a benign condition (47.8%, $p < 0.001$) and MIDP (50.5%, $p < 0.001$).

POM and failure to rescue (Table 3)

Overall POM was 3.9% (413 patients) and remained quite the same over the time. High volume centers had lower POM than low volume centers (3.4% vs 4.4%, $p = 0.012$). There was a linear increase of POM with age and ChCI. MIDP compared to open was associated with reduced POM (1.3% vs 4.7%, $p < 0.001$).

Among the overall 413 deaths, 355 occurred among patients with major post-operative complications. For 58 deaths, no relation with an eventful post-operative outcome was found in the PMSI database. Overall FTR was 11.2% and decreased along

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Table 3 90 days mortality and failure to rescue

Rate		Mortality	P	FTR	P
		413 (3,9%)		355 (11.2%)	
Hospital volume	<20/y	221 (4.4%)	0.012	180 (12.5%)	0.047
	≥20/y	192 (3.4%)		175 (10.2%)	
Teaching status	Yes	191 (3.5%)	<0.001	175 (10.3%)	<0.001
	No	222 (4.3%)		180 (12.4%)	
Sex	Male	252 (5.2%)	<0.001	220 (12.5%)	0.011
	Female	161 (2.8%)		135 (9.6%)	
Age	<50 yrs	16 (0.7%)	<0.001	14 (2.8%)	<0.001
	50–59 yrs	49 (2.2%)		45 (7.2%)	
	60–69 yrs	139 (4.5%)		122 (12.7%)	
	70–79 yrs	148 (5.8%)		132 (15.2%)	
	≥80 yrs	61 (9.9%)		42 (20.5%)	
ChCI	0–2	124 (1.9%)	<0.001	105 (7.2%)	<0.001
	3	80 (5.2%)		71 (13.0%)	
	≥4	209 (8.2%)		179 (15.6%)	
Chronic comorbidities	Pulmonary disease	159 (11.5%)	<0.001	147 (18.6%)	<0.001
	Myocardial infarction	51 (9.9%)	<0.001	42 (17.4%)	0.002
	Chronic heart failure	34 (12.0%)	<0.001	31 (18.3%)	0.003
	Peripheral vascular disease	24 (9.1%)	<0.001	55 (14.2%)	0.050
	Cerebrovascular disease	6 (12.0%)	0.003	6 (17.1%)	0.268
	Liver disease	70 (34.8%)	<0.001	69 (49.3%)	<0.001
	Chronic renal disease	36 (16.1%)	<0.001	35 (27.3%)	<0.001
	Metabolic disease	132 (5.0%)	0.001	116 (12.0%)	0.384
	Malnutrition	105 (6.1%)	<0.001	94 (9.8%)	0.082
	Obesity	38 (1.8%)	0.739	35 (11.4%)	0.934
Procedure	Open	381 (4.7%)	<0.001	336 (12.2%)	<0.001
	Laparoscopic	32 (1.3%)		19 (4.7%)	

time (13.8% between 2009 and 2011 vs 10.2% between 2015 and 2018, p = 0.039). FTR was significantly reduced in high volume centers compared to low volume centers (10.2% vs 12.5%, p = 0.047). There was a linear increase of FTR with age and ChCI. MIDP compared to ODP was associated with lower FTR (4.7% vs 12.2%, p < 0.001). In this study about DP, obesity was not related with higher POM or FTR.

Factors associated with POM (Table 4)

High volume centers were associated with reduced POM compared to low volume centers (OR = 0.570, CI95% [0.505–0.643], p < 0.001). Female gender was associated with lower POM compared to male (OR = 0.695, CI95% [0.625–0.773], p < 0.001). There was a linear increase of POM with age and ChCI (p < 0.001). All studied comorbidities were related with an increase of POM and malignant condition was associated with higher POM (OR = 1.889, CI95% [1.510–2.364], p < 0.001). Open procedure was related with an increased POM (OR = 2.768, CI95% [1.905–4.020], p < 0.001).

Factors associated with FTR (Table 4)

The same trends as POM were observed with FTR: high volume centers were associated with reduced FTR compared to low volume centers (OR = 0.550, CI95% [0.486–0.630], p < 0.001). Female gender was associated with lower FTR compared to male (OR = 0.767, CI95% [0.681–0.863], p < 0.001). There was a linear increase of FTR with modified ChCI (p < 0.001) and malignant conditions compared to benign were associated with higher FTR (OR = 1.590, CI95% [1.238–2.043], p < 0.001). Open procedures were related with increased FTR (OR = 2.520, CI95% [1.538–4.131], p < 0.001).

Discussion

Our nationwide study, conducted between 2009 and 2018 with 10,632 patients, found that the hospital volume has a positive impact on FTR in DP: centers with more than 20 pancreatectomies per year were associated with significantly lower FTR. High volume centers have to deal with more major complications

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Table 4 Predictive factors of POM and FTR

		POM		FTR	
		Odds Ratio; 95% CI	**p-value**	**Odds Ratio; 95% CI**	**p-value**
Hospital volume	<20/y	1		1	
	≥20/y	0.570 [0.505; 0.643]	<0.001	0.550 [0.486; 0.630]	<0.001
Sex	Male	1		1	
	Female	0.695 [0.625; 0.773]	<0.001	0.767 [0.681; 0.863]	<0.001
Age	Linear		<0.001		<0.001
Charlson score	Linear		<0.001		<0.001
Modified ChCI	<50*charlson	/		1	
	50-59*charlson			1.380 [1.300; 1.470]	<0.001
	60-69*charlson			1.915 [1.700; 2.150]	<0.001
	70-79*charlson			2.650 [2.220; 3.160]	<0.001
	≥80*charlson			3.670 [2.900; 4.650]	<0.001
Comorbidities	Pulmonary disease	2.459 [2.194; 2.756]	<0.001	1.782 [1.577; 2.013]	<0.001
	Chronic heart failure	1.588 [1.287; 1.958]	<0.001	1.345 [1.073; 1.686]	0.010
	Arrythmias	1.358 [1.139; 1.620]	0.001	1.230 [1.020; 1.482]	0.030
	Peripheral Vascular disease	1.529 [1.195; 1.957]	0.001	1.315 [1.001; 1.728]	0.049
	Neurological sequelles	1.498 [1.173; 1.913]	0.001	1.266 [0.974; 1.645]	0.077
	Liver disease	8.446 [7.101; 10.046]	<0.001	6.588 [5.477; 7.926]	<0.001
	Chronic renal disease	2.236 [1.780; 2.809]	<0.001	2.049 [1.608; 2.610]	<0.001
Pathology	Benign	1		1	
	Malignant	1.889 [1.510; 2.364]	<0.001	1.590 [1.238; 2.043]	<0.001
Approach	Laparoscopy	1		1	
	Open	2.768 [1.905; 4.020]	<0.001	2.520 [1.538; 4.131]	<0.001

than low volume centers, but they manage to have a reduced mortality among these complications, leading to lower FTR. After DP, these centers ensure an improved ability in the management of post-operative complications, avoiding death. We also identified patient characteristics related with higher risk of FTR: male gender, higher modified ChCI, malignant conditions. Moreover, MIDP was associated with lower FTR than open procedure.

FTR after pancreatectomy is known as high and is correlated to hospital volume.[4] Our study shows more specifically that in distal pancreatectomy, which has less mortality than pancreaticoduodenectomy, FTR is reduced in high volume centers. Details of major complications and causes of mortality were not studied here because many studies already described these mechanisms. Our aim was to focus on FTR itself, whatever were the causes of morbi-mortality. We observed a 29.6% overall morbidity, which is similar to other retrospective studies dealing with DP outcomes[9,37] and shows that DP still remains a challenging procedure. The incidence of major complications increased as advanced study period. This can be explained by the retrospective design and the use of the nationwide administrative PMSI database: with time, this database had become more and more exhaustive and complications that occurred in the beginning of the PMSI area were more likely not to be registered. Over the time, surgical teams may also have embarked in more difficult cases which could have resulted in higher complication rates. The 3.9% overall mortality in our study was higher than in series from other countries, with a mortality less than one percent, but these series were mainly from expert centers with a high volume of pancreatic resections.[9,18,37] This higher mortality must remain an issue for health care societies and confirms that failure to rescue is a pertinent data in distal pancreatectomy. Moreover, the mortality rate we observed could be explained by the fact that centralization in our country is not as efficient as in others. Indeed, almost half of the patients (47.5%) were operated in 602 low volume centers (95.4% of the centers), including very low volume centers.

POM and FTR we observed were close to those recorded in the last nationwide study between 2012 and 2015 about pancreatectomy and its subgroup dealing with DP: 3% mortality and 8.5% FTR.[4] In our study, centralization in DP has a positive impact on FTR, but operating DP in high volume centers may not be applicable to all patients. Our study underlined factors with a negative impact on FTR and targeted a population that could specially benefit from centralization in high volume centers: male gender, elderly and high modified ChCI, patients with

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malignant conditions. Mini invasive distal pancreatectomy is the treatment of choice for left sided pancreatic lesions,[31] our study showed that there are more MIDP in high volume centers and that the use of MIDP is related with lower mortality and FTR. The higher mortality rate and FTR observed in the ODP subgroup cannot be explained by a relation with more challenging procedures experienced in that arm. Indeed, even if the size of pancreatic lesions cannot be found in the nationwide database, other organs and extended or vascular resections were excluded from the study. Nevertheless, the benefits of mini-invasive approach are not yet demonstrated for pancreaticoduodenectomies.[38] Previous studies reported the relationship between hospital volume, outcomes and FTR,[13,20,25] suggesting that low FTR was related to specificities of these centers such as the expertise of multidisciplinary teams, the availability of IUC and emergency interventional procedures. But those studies did not use a standardized definition of FTR, with a lack of report in complications and with several definitions for high volume centers. We based our study on the same robust definition of FTR and hospital volume than El Amrani et al.[4]: we studied complications and their severity, the stay in ICU, the need for interventional radiology or reoperation to defined major complications after DP. Moreover we observed the same correlation between hospital volume and the teaching status of the centers as in the literature,[39] meaning that there is a close relationship between the ability of a center to teach and to promote high quality of care.

The limitations of our study lay in the retrospective design and the use of the nationwide administrative PMSI database. Even though the well-recognized status and the internal and external quality of the PMSI database,[33–36] the accuracy of coding and recording the patients relating data and outcomes can induce bias. Eventually, the use of such database did not allow us to study major parameters related to high quality of care such as the characteristics of the tumors and the surgery (size, stage, R0 resection status) and the overall survival of the population.[18] We either did not take into account the use of neoadjuvant chemotherapy which has a demonstrated impact on the postoperative course in pancreatic surgery.[1,5–8]

This nationwide analysis of 10,632 patients with DP from 2009 to 2018 reported that hospital volume has a positive impact on FTR and highlighted variabilities in the management of complications between high and low volume centers. Patients with high risk of FTR are men, with high modified Charlson comorbidity index, malignant condition and open procedure. Centralization in DP could ensure an improved management of major complications, leading to a lower FTR and a lower mortality, and should remain an issue for healthcare societies.

Conflict of interest

None declared

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