



Original research

Body Surface Area: A new predictive factor of mortality and pancreatic fistula after pancreaticoduodenectomy: A cohort-study



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HIGHLIGHTS

- BSA is a major prognostic role on post-operative mortality and pancreatic fistula after PD.
- BSA is an anthropometric parameter which is accurate to predict post-operative mortality and morbidity.
- BSA is an anthropometric parameter which is accurate to predict pancreatic fistula after PD.

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ABSTRACT

Introduction: To assess the role of Body Surface Area (BSA) in predicting pancreatic fistula and mortality after pancreaticoduodenectomy.

Methods: The data of patients who underwent pancreaticoduodenectomy between January 1992 to December 2012 at the University Hospital of Caen were collected prospectively and analyzed retrospectively. Pancreatic fistula was determined according to the ISPGF (International Study Group for Pancreatic Fistula) criteria. The Clavien and Dindo classification was used for grading post-operative complications and BSA was calculated according to the Boyd formula. Patients were classified as “large” and “non-large” using a BSA value ≥ 1.82 to define the large group and the non-large group. The primary end points were post-operative mortality rate, and the rate and grade of post-operative pancreatic fistula.

Results: 411 patients underwent pancreaticoduodenectomy with a mean age of 61.2 (± 12.1) year. Six patients (1.45%) died post-operatively. Patients with a BSA ≥ 1.82 had a significantly higher risk of post-operative death: OR 3.55 [1.43–8.80] ($p < 0.0005$). Eighty-five patients (20.7%) developed a post-operative pancreatic fistulas. The grade A pancreatic fistula rate was 87.1%. Patients with a BSA ≥ 1.82 had a significantly higher risk of developing overall post-operative pancreatic fistula ($p < 0.038$). Multivariate analysis showed that “large” patients (1.86, 95%CI[1.09–3.92], $p = 0.0229$), soft pancreas (6.5, 95%CI[2.39–9.31], $p = 0.0155$) and a BMI ≥ 25 (1.09, 95%CI[1.031–1.163], $p = 0.0407$) were independent risk factors of pancreatic fistula.

Conclusion: Body Surface Area is a useful factor after pancreaticoduodenectomy to predict mortality and post-operative fistula.

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1. Introduction

Recent improvement in peri-operative management of patients undergoing pancreatic surgery, and especially pancreaticoduodenectomy, have reduced mortality rates in most

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medical centers [1]. However, post-operative complications still occur in 40% of these patients [2,3].

Major post-operative complications require invasive procedures to manage and prolong hospital stay [4]. Post-operative pancreatic fistula occurs in 20–30% of patients and it is associated with increased post-operative mortality [3,5–7].

The prevalence of obesity has increased over the past decades in western countries. It is estimated that 15% of French are obese (Body Mass Index (BMI) > 30 kg/m²). Obesity is an independent factor of mortality, and also of complications in acute pancreatitis [8–10]. Several recent studies suggest that obesity increases blood loss and operative time and post-operative pancreatic fistula rate [12–14] in pancreaticoduodenectomy [11]. In most of these studies, obesity is determinate by the Body Mass Index calculation (BMI).

Nevertheless, the BMI calculation has some limitations which led other authors to use the Body Surface Area (BSA) measurement [15]. None of the previously published studies has highlighted the major prognostic impact of BSA in pancreatic surgery.

The aim of our study was to determine the impact of BSA on both post-operative mortality and pancreatic fistula rate after pancreaticoduodenectomy. The secondary aims were to assess its impact on post-operative morbidity.

2. Methods

2.1. Patients and data collection

The data were retrospectively analyzed from the prospectively maintained pancreatic database at the Department of Digestive Surgery, Caen University Hospital, France. All consecutive patients who underwent pancreaticoduodenectomy for benign and malignant periampullary lesions from January 1992 to December 2012 were included into this study. The data collected included patient demographics, clinical history of disease, past medical history (preoperative diabetes, cardiovascular disease), American Society of Anesthesiology Score (ASA), pre-operative clinical imaging, therapeutic interventions, pre-operative biliary drainage, per-operative data (operative time, intra-operative blood loss, type of anastomosis, caliber of Wirsung, pancreas texture) and post-operative data (hospital stay, mortality, pancreatic fistula rate). All fistulas were classified according to the ISPGF classification for patients who underwent PD after 2005 and were retrospectively reviewed to classify them when they were operated before 2005. According to the World Health Organization (WHO) definition, the Body Mass Index was reported and classified as following: overweight patient (BMI >25 kg/m²), obese patient (BMI > 30 kg/m²). The Body Surface Area was calculated according to the Boyd Formula: $BSA (m^2) = 0.0003207 \times (\text{Weight})^{0.7285-0.0188 \times \text{Log}(\text{weight})} \times (\text{Size})^{0.3}$. Due to the lack of data from previous studies on the impact of BSA on pancreatic surgery, we followed the procedure used in the study of Vaccaro et al. [15] to determine the threshold relative to the median. Thus, patients in our study were classified as “large” and “non-large” using the value $BSA \geq$ or <1.82 , respectively.

2.2. Surgical procedures

Pancreaticoduodenectomy were performed by laparotomy. Patients who had cancer underwent lymphadenectomy of the hepatoduodenal ligament, common hepatic artery and celiac axis regions. We did not performed pylorus preserving pancreaticoduodenectomy. The pancreatic anastomosis was performed according to the surgeons' preferences and the choice was between pancreatico-gastric (PG) and pancreatico-jejunal (PJ) anastomosis. Of the numerous techniques, PJ anastomosis was performed in our

Table 1
Patient characteristics according to the Body Surface Area.

Variables	BSA <1.82 m ²	BSA ≥1.82 m ²	P value
Age (mean ± SD)	59.7 ± 12.8	64 ± 10.2	0.009
Gender	244	167	0.024
Male (%)	122 (50)	137(82)	
Female (%)	122 (50)	30(18)	
BMI (kg/m ²)	22.2 ± 3.3	31.2 ± 9.2	<0.0001
Presence of diabetes mellitus (%)	20(8.2)	42(25.2)	0.527
Presence of cardiovascular disease (%)	14(5.7)	20(12)	0.854

*: Missed data. Bold signifies values with $p < 0.05$.

center with a side-to-end anastomosis without invagination of the pancreas into the digestive tract. PG anastomosis was performed through the posterior wall of the stomach with invagination of the remnant pancreas into the stomach.

2.3. Definitions of outcomes

The primary end points were post-operative mortality as calculated at 60 days after surgical resection, and the rate and the grade of post-operative pancreatic fistula. The secondary end points were any other post-operative complications, the length of operation and hospital stay. Post-operative complications were classified using the Clavien and Dindo classification [16]. Pancreatic fistula and delayed gastric emptying were defined according to the ISPGF classifications [5,17].

2.4. Statistical analysis

Statistics were performed using the SAS[®] software. Continuous variables were expressed as mean ± standard deviation (SD) or median and interquartile range (IGR) in populations with a skewed distribution. Differences between the two groups were analyzed using the Student's t-test, the Chi square test, or the Fisher's exact test as appropriate. All variables were tested for their independence using univariate analysis. Multivariable logistic regression was performed for variables with a p-value < 0.2 on univariate analysis, and for those which were known to be risk factors of mortality after pancreaticoduodenectomy (eg: age, ASA score ...). We used a forward logistic procedure when a collinearity between two variables was present. Then, the odds ratios were calculated. Confidence interval was determined to 95%. P values of less than 0.05 were considered as significant.

3. Results

3.1. Patients' characteristics (Table 1)

From January 1992 to December 2012, 411 patients underwent pancreaticoduodenectomy in our department. In this cohort, 244

Table 2
Peri-operative data.

Parameter	BSA <1.82 m ²	BSA ≥1.82 m ²	P value
Type of anastomosis*	241(98.8)	162(97)	0.307
PG (%)	210(87.1)	138(82.6)	
PJ (%)	31(11.7)	24(17.4)	
Operation time* (mean ± SD)	261 ± 68.1	311.9 ± 92.8	0.021
Intra operative blood loss* (mL)	37.3 ± 94.7	129.16 ± 298.4	<0.0001
Transfusion*(%)	3(1.3)	11(6.6)	0.0171
Hospital stay (mean ± SD)	20.3 ± 9.6	20.6 ± 12	0.062

* = Missed data. Bold signifies values with $p < 0.05$.

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