

Original article

Can the Estimation of Physiologic Ability and Surgical Stress (E-PASS) scoring system predict operative morbidity after distal pancreatectomy?

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Abstract

Purpose: Although mortality rates after pancreatic resection are below 5% in high volume centres, morbidity rates still remain high. Therefore, it is important to identify predictors for operative morbidity after pancreatic resection. The Estimation of Physiologic Ability and Surgical Stress (E-PASS) scoring system was developed for comparative audit of general surgical patients. We previously reported that E-PASS is useful to evaluate morbidity after pancreaticoduodenectomy. In this study, we evaluated whether the E-PASS scoring system can predict the occurrence of complications after distal pancreatectomy (DP).

Methods: Forty-six patients who underwent DP for pancreatic disease were studied. We determined correlations between the incidence rates of postoperative complications and the preoperative risk score (PRS), surgical stress score (SSS) and comprehensive risk score (CRS) of the E-PASS scoring system.

Results: Of 46 patients, 13 (28.3%) experienced a total of 20 postoperative complications. All E-PASS scores, particularly PRS and CRS, were significantly higher in patients with postoperative complications than in the patients without complications. The complication rate increased with increasing PRS, SSS and CRS scores.

Conclusion: The E-PASS scoring system is useful to predict morbidity after DP.

Introduction

Advances in surgical techniques and perioperative management have reduced the operative mortality rate after pancreatic resection to less than 5% of patients in high-volume centres; however, morbidity rates have changed little, and range from 30 to 40%¹⁻¹⁶. The majority of perioperative complications are not life threatening, but they increase the length of hospital stay and cost, may necessitate re-admission for appropriate care, and cause delays in adjuvant therapy. Thus, it is important to identify predictive and intra-operative risk factors associated with operative morbidity after distal pancreatectomy (DP).

Haga et al devised and validated the Estimation of Physiologic Ability and Surgical Stress (E-PASS) scoring system for risk stratification of patients undergoing elective general gastrointestinal (GI) surgery¹⁷. It has been externally validated in a different geographical setting from where it was originally developed and is reproducible for accurately predicting outcomes after elective GI surgery¹⁸. Furthermore, we have previously reported its usefulness for evaluating morbidity after pancreaticoduodenectomy (PD)¹⁹. This system comprises a preoperative risk score (PRS), a surgical stress score (SSS), and a comprehensive risk score (CRS), which is calculated from the PRS and SSS. E-PASS was based on the premise that morbidity and mortality rates are correlated with the patient's physiological risk and anticipated surgical stress.

The aim of this study was to evaluate whether the E-PASS scoring system could predict postoperative complications in patients undergoing DP.

Patients and methods

Patients and treatments

Between April 2005 and December 2007, 46 consecutive patients underwent DP at Kumamoto University for pancreatic malignant and benign diseases. Written informed consent was obtained from all patients before the treatment.

Three surgeons performed operations with almost uniform procedures. The pancreas was routinely transected with scalpel. The pancreatic duct was ligated, and the pancreatic stump was closed with monofilament sutures. A closed-suction drain was placed in the vicinity of the pancreatic stump. D2 lymph node dissection was performed in patients with pancreatic cancer²⁰.

E-PASS scoring system

The equations of the E-PASS scoring system are shown in Table 1. The PRS is calculated using factors such as age, presence or absence of severe heart disease, severe lung disease, and diabetes mellitus, American Society of Anesthesiologists (ASA) physiological status classification, and performance status index defined by the Japanese Society for Cancer Therapy²¹, which is the same as that defined by the Eastern Cooperative Oncology Group. The performance status index is defined as follows: grade 0, conditions without symptoms that restrict social activities; grade 1, conditions with mild symptoms that restrict muscular labour but do not restrict walking or mild exertion; grade 2, conditions that require some physical assistance for daily living; grade 3, conditions that require frequent physical assistance for daily living; grade 4, conditions that require constant physical assistance. Patients in grade 2 are not restricted to bed for more than half a day, those in grade 3 are restricted to bed for more than half a day, and those in grade 4 are restricted to bed all day. According to a previous study²², the expected in-hospital mortality rate was estimated as $Y = -0.465 + 1.192(\text{CRS}) + 10.91(\text{CRS})^2$.

Postoperative complication

The postoperative complications, except for postoperative pancreatic fistula (POPF), were assessed according to the National Cancer Institute Common Terminology Criteria for Adverse Events version 3.0 (NCI CTCAE v.3.0) ^{23, 24}. In this study, adverse events of grade 2–5 occurring within 30 days after surgery were considered to be postoperative complications. Adverse events corresponding to grade 1 were excluded because medical treatment was not required.

POPF was assessed according to an international study group (ISGPF) definition, that is a drain output of any measurable volume of fluid on or after postoperative day 3 with amylase content greater than 3 times the serum amylase activity²⁵. Three different grades of POPF (grades A, B, C) are defined according to the clinical impact on the patient's hospital course. Grade B and grade C were considered to be postoperative complications in this study. Grade A was excluded because it had no clinical impact.

The overall complication rate was defined as the proportion of patients with at least one complication. Operative and hospital mortality was defined as death within 30 days after surgery or during hospitalization, respectively.

Statistical analysis

We used the chi-squared test, Fisher's exact test and Mann-Whitney's U test for statistical analysis, as appropriate. Receiver operator characteristic (ROC) curves were plotted to assess the extent to which CRS, PRS and SSS could accurately predict morbidity. The area under the ROC curve (AUC) was used as a measure of overall diagnostic accuracy. Statistical significance was considered at $P < 0.05$.

Results

Patient characteristics

The study subjects included 27 female and 19 men. The median age of the patients was 63.5 years and ranged from 22 to 87 years old. Twenty six patients (56.5%) had malignant disease, including pancreatic cancer in 19, malignant islet cell tumour in four and malignant intraductal papillary mucinous neoplasm (IPMN) in three. The remaining 20 patients (43.5%) had benign diseases, including islet cell tumour in eight and chronic pancreatitis in five, benign IPMN in one, solid-pseudopapillary tumour in one, serous cyst adenoma in one, mucinous cyst adenoma in one, schwannoma in one, accessory spleen in one and pancreatic cyst in one. Our study showed that pancreatic texture at the stump of pancreatic remnant was soft and main pancreatic duct was not dilated in all patients except one.

Morbidity associated with distal pancreatectomy

Of the 46 patients, 13 (28.3%) experienced a total of 20 postoperative complications. The complications are listed in Table 2. There were no cases of operative or hospital death in this study. Neither intraperitoneal fluid collection nor abscess was observed in this study. POPF grade B, which grade requires a change in management or adjustment in the clinical pathway, was observed in all patients with post operative complications. POPF grade C, in which grade a major change in clinical management or deviation from the normal clinical pathway occurs, was not observed.

Correlations between E-PASS scores and postoperative complications

Postoperative complications was significantly correlated to performance status, ASA classification and blood loss, but not correlated to the other variables (Table 3).

The E-PASS scores, particularly PRS and CRS, were significantly higher in patients with postoperative complications than in patients without complication (Fig. 1). The mortality rate estimated using E-PASS scoring system was 3.4 % for patients with postoperative

complications.

The associations between PRS, SSS and CRS and complication rate are shown in Figure 2. The complication rate tended to increase as the PRS, SSS and CRS increased.

Receiver operating characteristic (ROC) analysis of the E-PASS scores for morbidity

The E-PASS scores showed good predictive power for morbidity associated with DP, which was demonstrated by the wide areas under the ROC curve in Figure 3. The AUC was 0.84 for PRS (95% confidence interval [CI] 0.72 to 0.97), 0.82 for SSS (95% CI 0.67 to 0.97) and 0.89 for CRS (95% CI 0.77 to 1.01). The ROC curves show the strong association between each of PRS, SSS and CRS with morbidity. Figure 3 shows various cut-off points for each graph. For CRS, a cut-off point of 0.43 would give a decision rule with sensitivity of 84.6% and specificity of 72.7% for the prediction of morbidity (Fig. 3c).

Discussion

While pancreatic surgery is currently associated with low mortality rates, particularly in high-volume centres, the rates of morbidity remain high. Indeed, in this study, the morbidity rate after DP was 28.3%, which is comparable with morbidity rates ranging from 30 to 40% in previous studies¹⁻¹⁴.

The E-PASS scoring system, which was developed for general surgical audit, has been applied to various sub-specialties^{18, 22, 24, 26, 27}. The system is easy to use because the required information can be retrieved from pre-anaesthetic sheets and from operation notes. Kaneko et al. assessed outcomes of laparoscopic hepatectomy (L-Hr) compared with open hepatectomy (O-Hr) for hepatocellular carcinoma (HCC) using E-PASS scoring system²⁸. SSS and CRS of the L-Hr group were significantly lower than those of the O-Hr group, although there was no difference in PRS between two different operations. Actually, the L-Hr group had a 10% complication rate, while the O-Hr group had a complication rate of 18%. It is indicated that E-PASS scoring system is useful for assessment of hepatectomy for HCC.

We previously reported the good predictive power of E-PASS scores for both mortality and morbidity, as demonstrated by the large areas under the ROC curve, in patients undergoing PD¹⁹. In this study, we used the E-PASS scoring system to predict operative morbidity after DP and found a strong correlation between E-PASS scores and the incidence of postoperative complications. The ROC analysis in this study indicates that E-PASS scores are useful predictors for postoperative complications after DP. The E-PASS system can be useful to predict operative morbidity after DP for each patient before surgery, using not only PRS, but also SSS and CRS which are calculated by expected operating time and blood loss. Therefore, surgeons, anesthesiologists, and medical staffs could estimate high-risk patients before surgery. Although there was no mortality in this study, E-PASS system might also help surgeons to consider the indication of DP for each case and avoid the operation for patient with too much high-risk. The E-PASS system can also inform patients about the risk of complications of themselves before surgery. Moreover, CRS had the best predictive utility for post operative

complications in this study. Then after the operation, surgeons can identify risk of morbidity shortly after surgery and patients would be sifted to perioperative care with necessary carefulness for each case, because SSS and CRS can be calculated immediately after DP using actual operating time and blood loss.

The most frequent complication in this study was POPF grade B. Some of previous studies have reported that pancreatic characteristics, such as soft pancreatic texture and pancreatic duct size, are predictors for POPF, including grade A^{1, 6}. Our study showed that pancreatic texture at the stump of pancreatic remnant was soft and main pancreatic duct was not dilated in all patients except one. Generally most patients underwent DP have soft pancreas and normal size of a main pancreatic duct. These distinguish from pancreatic characteristics in patients undergoing PD. Therefore, complications after DP, including POPF would possibly more reflect patient's own general condition and surgical stress, such as performance status, ASA classification and blood loss in this study, rather than pancreatic characteristics. Actually several studies indicated that patient's conditions, such as ASA classification, obesity and nutritional status, and surgical stress, such as blood loss and operating time affects the rate of post operative complications including POPF after DP^{3, 11, 29, 30}. E-PASS, especially PRS is easy to evaluate before DP. Moreover, systemic complications such as pneumonia would tend to occur in patients with high E-PASS scores. It is the most valuable point to assess E-PASS scoring before surgery.

In conclusion, the E-PASS scoring system is useful to predict operative morbidity, including POPF in patients underwent DP for pancreatic disease.

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Figure Legends

Fig. 1: Associations between postoperative complications and E-PASS scores (**a**; PRS, **b**; SSS, and **c**; CRS). Boxes show 95% confidence intervals. PRS, preoperative risk score; SSS, surgical stress score; CRS, comprehensive risk score.

Fig 2: Estimation of the proportion of patients with post-operative morbidity using E-PASS scores (**a**; PRS, **b**; SSS, and **c**; CRS). PRS, preoperative risk score; SSS, surgical stress score; CRS, comprehensive risk score.

Fig 3: ROC curves for morbidity based on E-PASS scores (**a**; PRS, **b**; SSS, and **c**; CRS). PRS, preoperative risk score; SSS, surgical stress score; CRS, comprehensive risk score.