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RESEARCH ATICLE

Pancreaticoduodenectomies in a Low Volume, Small Island Eastern Caribbean State: A Retrospective Cohort Study

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ABSTRACT

Background: Although pancreaticoduodenectomy (PD) is safe when performed in high-volume hospitals, many patients in low-income countries cannot access these hospitals. Barbados is a small island that does not have a high-volume pancreatic center. We sought to document peri-operative outcomes when PD was performed in Barbados.

Methods: We carried out a retrospective cohort study of all consecutive patients who underwent PDs over from August 1, 2016 to October 30, 2022. Therapeutic outcomes, post-operative morbidity and mortality were evaluated. Statistical analyses were performed using SPSS ver 16.0.

Results: Six patients at a mean age of 54.8 years underwent PD (mean annual case volume of 1). Two patients underwent planned vein resections and reconstruction. In this subset, the mean operating time was 325 minutes (Range 300-250; Median 325; SD ±35.4), mean estimated blood loss was 825mls (Range 750-900; Median 825; SD±106.1), and the mean transfusion requirement was 1 unit of packed cells (Range 0-2; Median 1; SD±1.41).

In the four patients without vein resection, mean operating time was 308 minutes (Range 280-350; Median 300; SD±24.01), median blood loss was 575 ml (Range 150-900; Median 700; SD±320.6) and mean transfusion requirements were 0.5 units of packed cells (Range 0-2; Median 0; SD ±0.84).

The mean ICU stay was 2.17 days (Range 1-3; Median 2.5; SD±0.98), and the mean duration of hospitalization was 9.3 days (Range 7-11; Median 9.5; SD±1.37). There were no recorded peri-operative deaths, but there was 1 (17%) minor complication (delayed gastric emptying) and 1 (17%) major complication (myocardial infarction).

Conclusion: In Barbados, there are good peri-operative outcomes after PD despite the low volume and challenging healthcare environment. We believe that (1) surgeon experience (2) continuous adaptive hospital learning and (3) regular audit of hospital data are better indicators of PD quality than volume data alone.

Keywords: Pancreas; Surgery; Pancreatectomy; Whipple; Pancreaticoduodenectomy

INTRODUCTION

There are existing data to show that pancreaticoduodenectomy (PD) to treat malignant peri-ampullary lesions is safe when performed in high-volume hospitals by trained pancreatic surgeons.[1-5] However, most high-volume centers are located in high-income nations[5] that are not easily accessible or affordable to many persons in low and middle-income countries. One such nation is Barbados - a small island state in the Eastern Caribbean with a total area of 166 miles^2 and a population of 286,641persons.[6]

Many Barbadians do not have access to high volume centers, and their only options are to undergo PDs in the resource-limited, low-volume local hospitals. Conventional wisdom suggests that outcomes would be poor in this setting.

The aim of this study was to document the outcomes when patients undergo PD in low-volume, resource poor hospitals in Barbados. A secondary outcome was to determine whether surgeon experience and adaptive hospital learning were better indicators of PD quality than volume data alone.

METHODS

In Barbados, the Government provides free healthcare to all residents through a network of public hospitals.[6] The sole tertiary referral hospital in this setting, the Queen Elizabeth Hospital, is centralized in the capital city of Bridgetown.[6]

At this facility, general surgical teams would perform PDs with the assistance of a visiting pancreatic surgeon who was not resident on island. In this scenario, varying degrees of operative and post-operative care were delivered by distance mentoring.[7-8] In the year 2021, a trained pancreatic surgeon repatriated, and began to perform PDs following a modified centralization concept previously described.[9] In our setting, we maintained a policy of mandatory ICU admission as institutional limitations did not allow the expected level of care outside the ICU setting.

After securing ethics committee approval, we carried out a retrospective cohort study of all patients who underwent PDs at the tertiary referral facility over a six-year period, from August 1, 2016 to October 30, 2022. Patients were identified from the operating theatre registers and their hospital records were retrieved for detailed examination. The exclusion criteria used in this study were patient age<16 years, incomplete records and/or missing data. The data extracted included diagnoses, performance scores, estimated operative blood loss, duration of operation (from incision to closure), therapeutic outcomes, post-operative morbidity and mortality. Complications were classified according to the modified Clavien-Dindo system.[10] Pancreatic leak was categorized according to the International Study Group on Pancreatic Fistula criteria. Cardiopulmonary complications included myocardial infarction, arrhythmia, congestive heart failure, pneumonia, pulmonary embolus, and respiratory failure. Statistical analyses were performed using SPSS ver 16.0.

Results

There were 6 patients with operable peri-ampullary neoplasms who underwent PD (mean annual case volume of 1). There were 2 men and 4 women at a mean age of 54.8 years (range 34-68; Median 57.5; SD±12.5). Two (33%) patients had at least one co-morbidity. Overall, there were 3 (50%) patients with ASA scores ≥III and 4 (67%) patients with ECOG scores ≥2. The commonest pathologic diagnosis was pancreatic ductal adenocarcinoma (3), as outlined in figure 1.

After pre-operative multidisciplinary review, we anticipated that the PD procedure would be technically complex in 2 (33%) patients due to vein involvement requiring resection and reconstruction.

Operative Details:

In two cases, PD was completed using an upper midline incision aided by a Thompson-Farley retractor. In these cases, reconstruction was performed using a single jejunal limb for the pancreatico-jejunostomy, hepatico-jejunostomy and gastro-jejunostomy. In the remaining four cases, a Maccuchi incision aided by an Omnitract retractor was used. In these cases, two jejunal limbs were used to create a hepatico-jejunostomy and a gastro-jejunostomy. The pancreatic duct was reconstructed using a pancreatico-gastrostomy.

Clinical Outcomes:

The mean operating time for open PD was 308 minutes (Range 280-350; Median 300; SD±24.01). The operations in these patients were accompanied by a median blood loss of 575 ml (Range 150-900; Median 700; SD±320.6) and mean transfusion requirements of 0.5 units of packed cells (Range 0-2; Median 0; SD ±0.84).

Two patients underwent planned vein resections and reconstruction, with primary anastomoses in 1 case and interposition graft in 1 case. In this subset of patients with anticipated technically complex operations, the mean operating time was 325 minutes (Range 300-250; Median 325; SD ±35.4), mean estimated blood loss was 825mls (Range 750-900; Median 825; SD±106.1), and the mean transfusion requirement was 1 unit of packed cells (Range 0-2; Median 1; SD±1.41).

In our practice, we followed a policy of mandatory ICU admission after PD because institutional limitations generally did not meet our expectations for supportive care outside of the ICU setting. The mean ICU stay was 2.17 days (Range 1-3; Median 2.5; SD±0.98), and the mean duration of post-PD hospitalization was 9.3 days (Range 7-11; Median 9.5; SD±1.37).

Morbidity / Mortality Analysis:

In this series, there were no recorded peri-operative deaths, but there was 1 (17%) minor complication (delayed gastric emptying) and 1 (17%) major complication (myocardial infarction). In the group of patients with complications, there was a mean ICU stay of 1.5 days (Range 1-2; Median 1.5; SD±0.71) and mean hospital stay of 9.5 days (Range 9-10; Median 9.5; SD±0.71). There was no significant difference when compared to the group without complications, in which the mean ICU stay was 2.5 days (Range 1-3; Median 3; SD ±1) and mean overall hospital stay was 9.25 days (Range 7-11; Median 9.5; SD±1.71).

Discussion

Despite the high risk associated with PD, it is still considered the gold standard since it is the only treatment with a potential to achieve cure of peri-ampullary malignancies.[11-12] The peri-operative mortality risk has improved significantly from 50-60% in the 1960s[13-15] to 4-6%[11,12,16-18] in the 21st century.

Most authorities attribute the improved morbidity profile to fellowship training,[19-20] use of specialized instrumentation,[5] availability of high-quality supportive care,[18-21] high-resolution imaging[1,19] and the multidisciplinary team approach.[1-2] Although our center was a low-volume facility, the pancreatic surgery teams invested in developing these concepts locally.

Another factor that is often praised is the concept of service centralization. This concept was popularized by large hospitals toward the end of the 20th century[3,4,15,16,17] when they published data showing significant reductions in complications,[1,2,22] peri-operative deaths,[1,2,14,22-25] duration of hospital stay[1,22] and treatment-associated cost [26] compared to smaller centers. However, there is no uniform definition for high volumes – the high-volume designation has been applied to centers performing as few as 3 [16,18,26] to >30 PDs per annum [22,27,28] in published literature.

Regardless of the definition, however, we acknowledge that our facility does not qualify as high-volume, with a case volume of 1 PD per annum. Conventional wisdom would suggest that PD should not be performed because poor outcomes would be expected in our setting. In addition to simple volume statistics, the outcomes would also be compromised by limitations of the local healthcare environments, such as scarce blood products, limited operating time, restricted intensive care support and resistance to multidisciplinary approaches to care.[5]

Despite these factors, however, we have demonstrated that peri-operative outcomes were still reasonable. When we analyzed data only from centers performing >18 PDs per annum, the 30-day mortality was only 4-6%.[1-4,11,15-18,22,25,29,30] There were no recorded peri-operative deaths in our series. In these high-volume centers, the reported major morbidity ranged from 16-26%.[1-4,11,15-18,22,25,29,30] Again, at 17% major morbidity after PD, the outcomes in this Barbadian center compared well to high-volume centers.

Many authorities advocate that only procedure-related complications should be recorded, such as post-operative pancreatic fistula, delayed gastric emptying, organ space infections and post-operative bleeding.[31] After PD in our setting, we encountered no procedure-related complications, except for one case of delayed gastric emptying.

In this paper we have demonstrated that good outcomes are achievable after PD even in the absence of high case volumes. We are not downplaying the contribution of volume and experience. We agree that PD is a complex operation and it relies heavily on surgeon experience, but we also agree that experience and volume are not synonymous. Experience includes factors such as the ability to identify anatomic variants,[32] perform venous reconstruction to achieve clear margins,[2] mature selection of patients,[32] and ability to contain intra-operative complications.[11] In this regard, we agree with Schmidt's concept of the "*experienced surgeon*". Schmidt et al[2] defined this as a surgeon who performed >50 PDs in their career, regardless of the interval – a distinct difference to the high-volume concept that could change every year. They also demonstrated that experienced surgeons with low annual volumes had equivalent outcomes to high-volume surgeons.[2] In Barbados, there were 2 experienced pancreatic surgeons, each having performed >100 PDs. Interestingly, Schmidt et al[2] used the number of portal vein reconstructions performed as a surrogate marker of technical complexity and surgeon experience. In our series, portal vein reconstruction rates were 33%, again highlighting the concept of surgeon experience.

We acknowledge that much of the experience was accrued in training hospitals during fellowship training. Upon repatriation to Barbados,

these surgeons had to adapt to and evolve in new healthcare environments by fostering inter-disciplinary cooperation and developing hospital-specific policies. This is described by many authors as the concept of continuous, adaptive institutional learning[1,2,11,22,33,34,35] and also played a part in the performance of this facility.

Some may argue that these outcomes are biased by case selection. However, our patient cohort was not physiologically optimal, because 50% had ASA scores ≥III and 67% had performance scores ≥2 and 33% had at least one comorbidity. Furthermore, we did not have the luxury of case selection because legally we were required to provide care for all patients admitted at this government-funded facility.

We believe that the factors contributing to good outcomes in Barbados were fellowship training for surgical staff, continuous adaptive learning by the hospital, regular audit of clinical outcomes and knowledge of our population-based data. These factors should be used as markers for PD quality instead of case volume data alone.

Conclusion

In Barbados, there are good peri-operative outcomes after PD despite the low volume and challenging healthcare environment. We believe that (1) surgeon experience (2) continuous adaptive hospital learning and (3) regular audit of hospital data are better indicators of PD quality than volume data alone.

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Author contributions: All authors contributed equally to this manuscript.

Ethics approval: This study was approved the the local ethics committee

Patient consent: Patient consent for publication was not required as this study involved retrospective analysis of data.

Competing interests: The authors have no competing interests to declare

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