



Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Short term outcomes and unintended benefits of establishing a HPB program at a university-affiliated community hospital

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ARTICLE INFO

Article history:

Received 4 April 2018

Received in revised form

9 March 2019

Accepted 13 March 2019

Keywords:

HPB surgery outcomes

Complex surgery in the community

HPB resident education

ABSTRACT

Background: In hepato-pancreato-biliary (HPB) surgery higher volumes are associated with improved outcomes; however, there are limitations to regionalization. Here we report our experience establishing multidisciplinary HPB program at a university-affiliated community hospital.

Methods: This is a retrospective review of patients who underwent HPB surgery between 2015 and 2017. Chief residents' HPB case logs were collected.

Results: 61 pancreatic resections and 62 hepatic resections were performed. The morbidity, 30-day mortality and median length of stay following pancreatic resections were 27%, 1.5%, and 8 days, respectively. The morbidity, 90-day mortality, and median length of stay following hepatic resections were 24%, 3%, and 7 days, respectively. The median pancreatic and liver case volumes for graduating chief residents increased from 7 to 8 to 16 and 16, respectively ($p < 0.05$), after the establishment of a HPB program. Participation in multidisciplinary care ($p = 0.08$) and clinical trial enrollment increased.

Conclusion: Our study demonstrates short-term outcomes comparable to high volume centers. Development of a HPB program had a positive impact on resident operative experience, increased multidisciplinary care and increased clinical trial enrollment.

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Introduction

Numerous studies have shown a relationship between hospital and surgeon volume and perioperative outcomes in complex surgical procedures.^{1–9} This relationship between volume and outcome is especially pronounced in hepatobiliary and pancreatic surgery where differences in mortality have been shown to be two or three times higher in low volume centers compared to high volume centers. In addition to improved short-term outcomes, there have also been reports that oncologic variables such as margin negative rate, receipt of adjuvant chemotherapy and overall survival are better at institutions where these complex surgeries are done more frequently.¹⁰ These findings have been the impetus in the push towards regionalization of complex oncologic operations. Numerous healthcare organizations have embraced this effort to regionalize complex operations with a slight increase in

the proportion of pancreas and liver resection performed at high volume centers.

Despite the overall benefits of regionalizing healthcare, there are some limitations; studies have shown that regionalization has in some instances resulted in increased or increasing racial and socioeconomic disparities between those who can receive care at high volume centers and those who receive care at low volume hospitals.^{11–13} Numerous patients lack the means or are greatly inconvenienced by travelling to outside institutions to receive care.¹⁴ Patient perceptions and the factors that affect their choice on where to have surgery have also not been well studied. Furthermore, there are challenges to patient choice associated with insurance carriers and preferred providers as well. These spatial and nonspatial barriers to access impact receipt of care. In addition to patient considerations, there could be unintended negative consequences to the practicing general surgeon in the community, the financial viability of community hospitals potentially impacting quality of care and the education of surgical residents who train in hospitals considered to have low volume for complex surgical procedures.^{15,16}

There are those who argue that volume alone should not be

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used to determine where patients receive complex oncological surgery.^{17,18} Rather it should be based on an objective appraisal of both risk-adjusted short and long-term outcomes at individual institutions.¹⁹ The goal of our study is to evaluate our short-term results in the establishment of an HPB program, its effect on resident education, and other accrued benefits to HPB patients in the community.

Methods

A new hepato-pancreatico-biliary (HPB) program was established in November 2015 as a collaboration between West Michigan Cancer Center (WMCC) and Western Michigan University Homer Stryker M.D. School of Medicine Department of Surgery (WMED). A prospectively maintained database of all pancreatic and hepatobiliary surgeries was reviewed over the first two years of the program. All procedures were performed at one of two community-based teaching hospitals affiliated with the WMED surgery residency, either Bronson Methodist Hospital (BMH) or Borgess Medical Center (BMC). Both hospitals are level 1 and 2 trauma centers respectively where complex cardiovascular, trauma, vascular and neurosurgical services are performed.

The impetus to develop an HPB program came after a primary market evaluation demonstrated that a majority of patients in our community travelled for HPB surgery. Following the market analysis both community hospitals were approached by WMED and WMCC, and a multiyear consultative process involving all stakeholders in the community was conducted. Stakeholders included administrative and clinical representatives from both hospitals, gastroenterologists, medical oncologists, general surgeons, and specialist surgeons in the community. Once community need was recognized, and program support from the four institutions was assured, an HPB surgeon was recruited. Institutional support included dedicated OR time, new equipment (retractors, open and laparoscopic ultrasound, microwave ablation system), recruitment and retention of advanced endoscopy services, general surgery coverage, advanced interventional radiology, palliative care, radiation oncology, fellowship trained pathologists, vascular surgery, urology and ICU support. After recruitment, marketing was performed at all medical institutions to inform and educate the community about new technologies and HPB services available. While specifically targeting medical oncologist, gastroenterologists, general surgeons and primary care physicians in the region, this involved in person meetings, grand rounds presentations and participation in community medical events including morbidity and mortality conferences. Additionally, professional photography, flyers, business cards, and a dedicated website for practice description, physician background, and information regarding appointments was created.

Dedicated clinical space and services were provided at WMCC including nursing support, social work, dietician services, financial counseling, and genetic counseling. Multidisciplinary gastrointestinal conference frequency was increased and a multidisciplinary clinic was established with medical oncology, radiation oncology and support services once every two weeks. An inaugural multidisciplinary conference on pancreatic cancer supported by the WMCC and WMED was held with regional and national experts to educate the medical community on recent advances. Inpatient support was provided by dedicated resident teams lead by a 4th or 5th year general surgery resident which included advanced practice providers.

Descriptive data for demographics, indication for procedure, and procedure type were reported for pancreatic and hepatic resections separately. Perioperative outcomes included operative time, estimated blood loss, length of stay, complications, need for

reoperation, readmissions and 30/90 day mortality. Complications were scored using the Clavien-Dindo classification.²⁰ Clavien-Dindo complication equal to or greater than 3 was considered a major morbidity. Outcomes specific to pancreas resections included pancreatic fistula and delayed gastric emptying according to the International Study Group on Pancreatic Fistulas (ISGPF).²¹ R0 resection margin was defined as >1 mm margin. Hepatic resection specific outcomes were bile leak and post-hepatectomy liver failure based on the International Study Group of Livery Surgery (ISGLS).²² Hepatobiliary procedures included formal hepatectomy, segmentectomy, wedge resections and microwave ablation.

The WMED surgical residency program graduates two chief residents a year and has recently increased the complement to three residents. Pancreatic and hepatic resection numbers were obtained from the case logs of graduating chief residents' from 2011 to 2017 and were compared before and after the establishment of the HPB program.

WMCC is an NCI community oncology research program with access to multiple national trial groups. Data for trial enrollment in pancreatic adjuvant trials was obtained from 2014 to 2017. A weekly multidisciplinary conference lead by a surgical oncologist, including medical oncologists, radiologists, pathologist, gastroenterologists, radiation oncologists, colorectal surgeons and other medical specialists is held at WMCC. The multidisciplinary conference followed NCCN guidelines regarding management of pancreatic and hepatobiliary malignancies. Data regarding numbers and type of cases was abstracted from 2014 to 2017.

Descriptive and statistical analysis was performed using Microsoft Excel with a p value less than 0.05 considered significant. Joinpoint software by NIH was used to test the data for a statistically significant trend in HPB cases, using a Monte Carlo permutation method. The proportion of HPB cases was set as the dependent variable, and the year was set as the independent variable. The institutional review board of the WMCC approved this study.

Results

Pancreas surgery

Sixty-one patients underwent pancreas resections. Patient demographics, indications for procedures and operative procedure are shown in [Table 1](#). The primary indication for surgery was for adenocarcinoma and the majority underwent pancreaticoduodenectomy (Whipple procedure).

The outcomes for patients who underwent pancreas resections are shown in [Table 2](#). For Whipple procedure and distal pancreatectomy, the median operative time was 6 and 3 h, median estimated blood loss was 500 mL and 200 mL, and median length of stay was 9.4 and 6 days respectively. There was one death. Major complications, as defined by a Clavien-Dindo classification of greater than 3, was 29%. The mortality occurred due to bleeding from the bilio-pancreatic limb twenty days after initial discharge and subsequent readmission after a Whipple procedure for periampullary carcinoma. The rates of pancreatic fistula and delayed gastric emptying were 21.3% and 22.9% respectively.

Hepato-biliary surgery

Sixty-two patients underwent hepatic resections. Patient demographics, indications and operation type are shown in [Table 3](#). The primary reason for resection was the presence of metastatic disease with 44% of patients (27/62) undergoing segmentectomy. There was no difference in the number of resections performed in year one compared to year 2. Perioperative outcomes are shown in [Table 4](#). Median operative time was 210 min and median length of

Table 1
Pancreas demographics.

Total patients (n)	61
Age (median, years)	65
Female (n, %)	39 (63.9%)
Comorbidities	
Hypertension	36 (59.0%)
Coronary disease	16 (26.2%)
Pulmonary disease	16 (26.2%)
Preoperative diabetes mellitus	18 (29.5%)
BMI (median, kg/m ²)	26.3
ASA (median)	3
Preoperative Albumin (median, g/dl)	3.6
Main pathology	
Pancreatic ductal adenocarcinoma	33 (54.1%)
IPMN ^a	4 (6.6%)
Periapillary mass	3 (4.9%)
Neuroendocrine tumor	8 (13.1%)
Chronic Pancreatitis	1 (1.6%)
Duodenal carcinoma	1 (1.6%)
Metastatic disease	1 (1.6%)
Other (benign, mucinous neoplasm.)	10 (16.4%)
Operation	
Pancreaticoduodenectomy	37 (60.7%)
Partial pancreatectomy, ± splenectomy	23 (37.7%)
Pancreatic enucleation	1 (1.6%)

^a Intraductal papillary mucinous neoplasm.

Table 2
Pancreas perioperative outcomes.

Outcome variable	Pancreas (n = 61)
Operative time (median, hrs)	
Whipple	6
Distal pancreatectomy	3
Length of stay (median, days)	
Whipple	9.4
Distal pancreatectomy	6
Estimated Blood Loss (median, mL)	
Whipple	500
Distal pancreatectomy	200
30 day Mortality	1 (1.5%)
Major Complications	15 (24%)
Clavien-Dindo Classification	
Grade 1	13 (21.3%)
Grade 2	6 (9.8%)
Grade 3	12 (19.7%)
Grade 4	6 (9.8%)
VTE ^a	3 (4.9%)
POPF ^a	13 (21.3%)
DGE ^a	14 (22.9%)
SSI ^a	6 (9.8%)
GI bleed	2 (3.3%)
Reoperation	4 (6.6%)
Readmission	4 (6.6%)
Positive Margins	8 (13.1%)

^a VTE venous thromboembolism, POPF post-operative pancreatic fistula, DGE delayed gastric emptying, SSI surgical site infection.

Table 3
Hepatobiliary demographics.

Total Patients (n)	62
Age (median, years)	58
Female (n, %)	26 (42%)
Comorbidities	
BMI (median, kg/m ²)	28
ASA (median)	3
Albumin (median, g/dl)	3.6
Primary Liver (n, %)	23 (37%)
Main Pathology	
Metastatic disease	21 (34%)
HCC ^a	13 (21%)
Cholangiocarcinoma	7 (11%)
Gallbladder Ca	3 (5%)
Benign disease	14 (23%)
Operation	
Major Hepatectomy	20 (32%)
Segmentectomy	27 (44%)
Wedge	3 (5%)
Microwave ablation	7 (11%)

^a HCC hepatocellular carcinoma.

Table 4
Hepatobiliary perioperative outcomes.

Outcome variable	Hepatobiliary Resection (n = 62)
Operative time (median, min)	210
Estimated Blood Loss (median, mL)	350
Length of Stay (median, days)	7
90 day Mortality	2 (3%)
Major Complications	15 (24%)
Clavien-Dindo Classification	
Grade 1	8 (13%)
Grade 2	6 (10%)
Grade 3	8 (13%)
Grade 4	5 (8%)
VTE ^a	2 (3%)
Bile leak	4 (6%)
Post hepatectomy liver failure	3 (5%)
SSI ^a	2 (3%)
Reoperation	2 (3%)
Readmission	9 (15%)
Positive Margins	4 (6%)

^a VTE venous thromboembolism, SSI surgical site infection.

Resident training

The median pancreatic and liver case volumes for graduating chief residents increased from 7 to 8 to 16 and 16, respectively ($p < 0.05$) despite an increase in the number of graduating residents from two to three a year.

Multidisciplinary care

All patients who underwent surgical resection were evaluated at the multidisciplinary conference. There was an increase in the proportion of HPB cases at the gastrointestinal multidisciplinary conference from 14% to 44%, however the joinpoint model slope shown in Fig. 1 was found to be statistically insignificant ($p = 0.08$). 79% of patients (27/34) with pancreatic adenocarcinoma who were recommended to receive adjuvant therapy started their treatment within 60 days of surgery. Of the 14 patients eligible for clinical trial enrollment, 4 patients were enrolled in the only adjuvant trial available at our institution (RTOG 0848). Prior to the HPB program there had not been any enrollments in adjuvant pancreatic cancer clinical trials. Of the hepatobiliary surgery patients, 31 patients were recommended to receive adjuvant and/or chemo-radiotherapy, and of those, 25 (80%) patients received adjuvant

stay (LOS) was seven days. There were two deaths (3%) with major complications occurring in 15 (24%) patients. One mortality was due to post-operative hemorrhage and subsequent respiratory failure after a left hepatectomy for a large neuroendocrine tumor. The other mortality was due to post-operative ventricular fibrillation and cardiac arrest after hepatic metastasectomy from colorectal cancer. Post-operative bile leak and post hepatectomy liver failure was 6% and 15% respectively. There were nine (15%) readmissions.

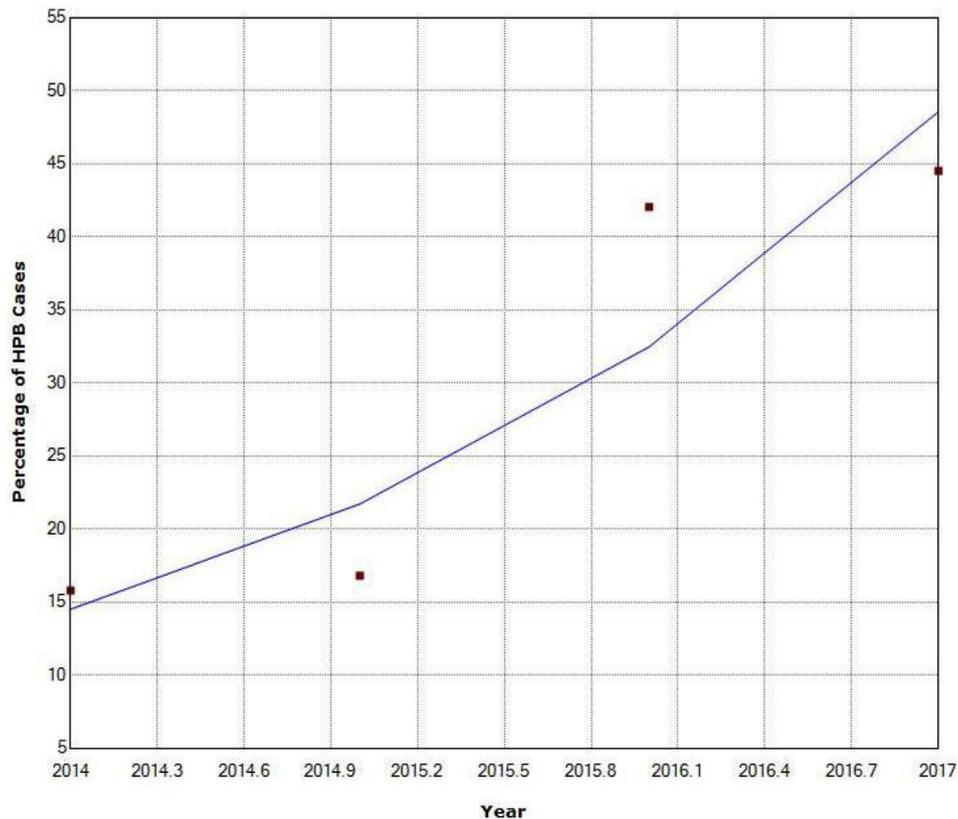


Fig 1. HPB cases at multidisciplinary conference.

therapy with five refusing and one incapable due to poor functional status.

Discussion

Regionalization of complex surgical procedures to higher volume centers results in better short-term outcomes and improved oncological outcomes.^{1–9} The advantages of regionalizing care have been widely disseminated in medical journals and in national media sources leading to the acceptance of the significance of volume and its impact on outcome by physicians, patients and hospital administrators. This has created significant impediments in establishing, developing and maintaining a complex surgery program outside major academic centers. Volume, which is easier to define, rather than outcome driven metrics are often the determining factor in physician and patient referral patterns and subsequently cited by hospital administrators as reasons why certain patients should be referred. However, there are numerous factors that limit regionalizing all care to quaternary care centers and documented disadvantages include increasing socioeconomic and racial disparities in access to specialized care.^{11,12,23} Contrarily, there is data to suggest that complex surgery performed outside these centers by a dedicated team can provide comparable outcomes and that it is the “who not the where that impacts outcome.”^{19,24} At our newly established HPB program we demonstrated equivalent short-term outcomes in pancreatic surgery comparable to high volume centers with a mortality of 1.6% and no mortality in the second year of the program. The major morbidity rate at our center was determined to be 24% and 21.3% of our patients had a grade C or higher pancreatic fistula which is comparable to high volume centers. Other metrics such as LOS, and readmissions also appeared to be similar to reported rates from

high volume institutions.^{7,9}

Given the length of time of our program we could not examine survival data, but to evaluate the quality of our pancreatic cancer care we looked at lymph node yield, R0 resection rate, multidisciplinary evaluation and receipt of adjuvant chemotherapy^{25,26}. Despite our overall median lymph node yield being 15 lymph nodes for patient who underwent pancreaticoduodenectomy, the percentage of patients who underwent an adequate lymph node (<15) harvest was only 62.5% over the two years. After initial review at the end of the first year, a concerted effort by both the surgeon and pathologist resulted in 80% of patients in the second year having an adequate lymph node harvest compared to only 36% in the first year. Our R0 resection rate was 86.9% comparable to most high volume centers in the country despite very few of our patients receiving neoadjuvant therapy. All patients were discussed at our multidisciplinary conferences and 79% were able to abide to the recommendation of adjuvant therapy either on or off clinical trial. The rate of receipt of adjuvant therapy at our institution is comparable to the reported rate from high volume centers.²⁷ Interestingly our retrospective evaluation showed an increase in clinical trial enrollment that is likely a result of increased multidisciplinary care and awareness of available clinical trials.

It has been suggested that expertise in one area of HPB surgery does not necessarily translate into other related areas, we therefore sought to evaluate our HPB experience.²⁸ The mortality and major morbidity rate of 3% and 24% respectively during the study period was also found to be comparable to higher volume centers. length of stay and readmission rates were comparable to those that have been reported ranging from 4 to 7 days and 9–13% respectively.²⁹ Dixon et al. reported on the development of quality indicators which include structure, process and outcome in colorectal metastases (CRM) liver resection using a Delphi process.³⁰ These

indicators were used as a starting point to audit our program. In terms of structure and process our program met all the quality indicators. Some of the quality indicator outcome measures suggested such as bile leak <5%, liver failure <5% were met; however our mortality and R0 resection were slightly higher. The reported quality indicators were designed for CRM, however our experience includes other HPB malignancies with traditionally higher rates of R1 resection and could therefore explain the higher rates of positive margins. CRM R0 rate, in our study, was 100%. Although the mortality was slightly higher at 3% it is comparable to other reported population and institutional rates. It is, however, an area that merits further auditing as the program matures.

The educational impact of regionalized complex HPB surgery has not been well studied, but some research has shown decreases in the overall experience of HPB surgery due to regionalization. Nationally residents have also expressed a lack of familiarity or comfort with advanced HPB procedures.^{31,32} The impetus for developing a HPB program at this institution was a perceived deficiency in HPB experiences and training expressed by previous graduating residents. After the introduction of a HPB program, there was a resultant 2-fold increase in both hepatobiliary and pancreas cases performed by graduating chief residents. Prior to the introduction of an HPB program, majority of the resident experiences in liver and pancreas were reported as open biopsies/wedge and pancreas cyst drainage procedures. Since then formal liver and pancreas resections were more often performed, demonstrating an impact on both the number and type of experiences residents' received. In the last two years the graduating chief residents have not reported HPB surgery as an area of perceived deficiency. The educational goal is not and should not be to prepare graduating chief residents to perform these surgeries but to expose them to basic techniques in HPB surgery that are useful in the practice of general surgery. In addition to operative experience, exposure to peri-operative management of HPB patients in the hospital, in multidisciplinary conference and in morbidity and mortality conferences improves understanding of HPB pathology, which is useful to a surgeon in any setting. HPB is an essential component of general surgery training and is translatable to numerous other general surgery specialties.³³

Limitations to our study include the inherent biases associated with a single institution retrospective study, and the selection bias associated with case selection in a new center. In addition, our results may not be reproducible in other lower volume community centers given that the program, during its growth, developed into a high volume center for both pancreatic and liver resections. Cost and oncological outcome was not evaluated but will be the subject of future research endeavors.

The goal of this study was to demonstrate that developing a high quality multidisciplinary HPB program at a university affiliated community hospital with adequate resources is feasible and provides educational benefits in addition to cancer care process and system benefits. This study does not argue against centralization of care but rather is in favor of objective, continuous appraisal of all centers that provide HPB surgery to ensure quality is maintained for patient benefit. There are potential advantages to having a high quality HPB surgery program in the community. The resection rate for localized pancreatic cancer has remained low despite improved outcomes possibly due to continued misconceptions among the general public and medical community.³⁴ These misconceptions also apply to the resectability of colorectal metastases to the liver.³⁵ Perceptions within the medical community change as they directly participate in the care of patients in the community. Education of the local public and the regional medical community can also be more effective when it comes from a local physician who is easily accessible and available for questions and concerns.³⁶ Development

of an HPB program in this community was possible because the underlying infrastructure was already in place i.e. 24hr surgical ICU care, 24hr senior resident coverage, advanced endoscopy, interventional radiology, and hospital and nursing staff accustomed to taking care of patients undergoing complex cardiovascular, trauma, vascular and neurosurgical procedures. Outpatient clinical services were provided at the cancer center thereby ensuring multidisciplinary, patient centered care due to the presence of cancer related services and specialists. An integral component in the development of the program was the commitment by the 4 medical institutions in the community to support the program with any necessary capital purchases, educational programs, senior resident coverage and clinical services.

In conclusion, development of a high quality multidisciplinary HPB program in well selected communities has the potential to make complex HPB surgery more accessible without the documented disadvantages of regionalization. Other potential unintended benefits of a HPB program seen at our institution were increased resident experience, increased multidisciplinary care for HPB malignancies and increased clinical trial enrollment.

Acknowledgements

We would like to acknowledge and thank the following individuals involved in programmatic development and support of the clinical program; Earl Norman MD, Joseph Mirro MD and Eleanor Bannigan BSN.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amjsurg.2019.03.015>.

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