

Hospital-level resource use by the oldest-old for pancreaticoduodenectomy at high-volume hospitals

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Introduction. Owing to limited data on hospital resources consumed in caring for the oldest-old, we examined the use of pancreaticoduodenectomy (PD)-relevant hospital resources in patients of increasing age treated in high-volume hospitals participating in the University HealthSystem Consortium.

Methods. Perioperative outcomes, resource use, and direct costs were compared across increasing age groups in 12,766 PDs (<70 years, n = 8,564; 70–79 years, n = 3,302; ≥80 years, n = 900) performed in 79 high-volume hospitals between 2010 and 2014. Linear regression models with and without covariate adjustments were used to assess the impact of older age.

Results. The oldest-old experienced fewer readmissions and had equivalent intensive care unit use and mortality rates compared with both younger cohorts. However, those ≥80 years experienced more complications, blood transfusions, greater total parenteral nutrition (TPN) use, longer duration of stay, and higher direct hospital costs compared with those <70 years. No differences were found between patients ≥80 years and those 70–79 years with respect to the administration of blood products, TPN, or the direct cost of PD.

Conclusion. Our findings suggest the ability to deliver quality pancreatic surgical care to an aging population without strong associations to increased resource utilization. As the number of octogenarians undergoing PD continues to grow, the impact of this technically complex procedure on other important cancer care metrics, including patient-reported outcomes and quality of life, requires further assessment. (Surgery 2015;158:366-72.)

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IT IS WELL-KNOWN that patients of advanced age are more susceptible to adverse perioperative events.¹ With a looming, predicted expansion of 350% over the next 30 years for those ≥80 years, the consumption of health care resources may similarly increase.² Medicare data suggests aggregate 5-year net costs of cancer care for patients

>65 years of age to be >\$21 billion.³ Pancreatic malignancy remains a serious disease, which places strains and financial burdens on our health care system.⁴ Currently, the median age at the time of diagnosis of pancreatic ductal adenocarcinoma is 72 years with 42% of patient's being ≥75 years.⁵ Pancreaticoduodenectomy (PD)

Funding: Clinical Translational Science Award (CTSA).

The authors certify that all individuals who qualify as authors have been listed; each author has participated in one or more of the following areas: conception and design of this work, the acquisition and/or analysis of data, the writing, and/or critical revision of the document, and supervision of this cooperative research effort. All contributing authors approve of the submission of this version of the manuscript and assert that the document represents valid work. If information derived from another source was used in this manuscript, we obtained all necessary approvals to use it and made appropriate acknowledgements in the document. All contributing authors take public responsibility for this work.

This project has been funded in part with Federal funds (Grant # UL1TR000101 previously UL1RR031975) from the National Center for Advancing Translational Sciences (NCATS), National Institutes of Health (NIH), through the Clinical and

Translational Science Awards Program (CTSA), a trademark of DHHS, part of the Roadmap Initiative, "Re-Engineering the Clinical Research Enterprise."

Presented at Academic Surgical Congress 2015/Association of Academic Surgeons/Society of University Surgeons, Las Vegas, Nevada, 2015.

Accepted for publication February 21, 2015.

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0039-6060/\$ - see front matter

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<http://dx.doi.org/10.1016/j.surg.2015.02.022>

remains the only curative treatment modality with a median overall survival after resection of approximately 26 months with only 25% of resected patients surviving 5 years.⁶⁻⁸ We speculate that with the growing pressure to deliver high-level, quality cancer care while simultaneously containing costs, the marginal increase in survival afforded by PD for octogenarians may come under scrutiny by health policy officials.

Despite considerable data focused on the morbidity of PD, a paucity of data remains on the financial impact of this technically complex surgery. According to the National Inpatient Sample and Healthcare Cost and Utilization Project databases for 2005, the average hospital charge for a patient who underwent PD was >\$100,000.⁴ Although this value incorporates diagnostic examinations and may not truly depict the cost of care delivered, it is certainly not insignificant.⁴ In addition to this value, the costs of adjuvant therapy, skilled care facilities, and end-of-life care can increase exponentially the overall cost of resected pancreatic cancer.⁴ Quality and cost remain 2 of the most prominent forces driving decision making in health care policy today. The future potential for resource limitations has led payers to challenge physicians to deliver care that is both effective and efficient.⁴ Therefore, it is imperative to identify, understand, and mitigate the drivers of potential increased costs and identify whether or not they are age related.

Although the safety and efficacy of performing complex pancreatic resections in patients >80 years remains controversial, there are a paucity of data on the hospital resources consumed and the cost of care for the oldest-old.^{1,9} Therefore, we previously examined post-PD outcomes and resource use in cohorts of increasing age at our own institution and found perioperative outcomes and complications comparable between all age groups and the total charge differential equal between septuagenarians and octogenarians. Herein, we sought to expand this preliminary, single academic high-volume hospital study to a large, diverse sample of high-volume hospitals to improve understanding of age as a driver of resource utilization. Based on our preliminary work, we postulate that PD surgical hospitalization resource use would be higher among patients ≥ 80 years at high-volume hospitals.

METHODS

The Georgetown University Hospital Institutional Review Board reviewed and approved this study (study #2010-354). The data used in this

study were extracted from a large, clinical database maintained by the University Healthcare Consortium (UHC). The UHC is a multihospital cooperative that collects and compiles discharge data submitted by members on a quarterly basis. The UHC then makes standardized diagnostic, resource utilization, and cost data aggregated at the hospital level available to members through a secure, interactive, web-based interface. We used the database to identify 83 high-volume hospitals performing a total of ≥ 44 PDs between 2010 and 2014 identified based on the International Classification of Diseases, Ninth Revision (ICD-9), procedure code 527. We defined very high-volume hospitals as those performing a number equal to or greater than the median number of PDs performed by high-volume hospitals in our sample during our study period, which was 130 PDs.

For each hospital in the sample, we extracted aggregated data on patient comorbidities, outcomes, and resource use for PD patients stratified into 3 age categories (<70, 70–79, and ≥ 80). We employed UHC's standardized, Agency for Healthcare Research and Quality–based measure of the mean number of comorbidities per patient in each group of patients of a given hospital that were in the same age cohort.¹⁰ Our outcome measures included proportions of patients experiencing 6 different perioperative and postoperative complications as identified by ICD-9 diagnostic codes; 7-, 14-, and 30-day rates of readmission to the index (discharging) hospital; and 7-day mortality rates. Our resource measures included the proportion of patients using total parental nutrition (TPN) and blood transfusions (as identified based on ICD-9 procedure codes listed in [Table I](#)), the proportion using an intensive care unit and average duration of stay. Direct cost of care was calculated by the UHC based on detailed charges and cost-to-charge ratios reported to the UHC by member hospitals and excluded overhead costs associated with hospital operations that do not vary by patient. We excluded from our analysis hospitals that reported <5% of their PD patients having used TPN as a proxy for poor data quality. Our final sample included a total of 79 high-volume hospitals.

We estimated linear regression models to measure the strength and statistical significance of hospital-level associations between age and resource use and outcomes of care. We weighted our analysis based on the number of patients represented in a given hospital–age cell. We used robust regression to account for unequal variance induced by differences in the number of patients in each hospital–age cell. We estimated models

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