

Original article

Is there a relationship between leapfrog volume thresholds and perioperative outcomes after radical cystectomy?

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Abstract

Objective: Threshold levels for hospital volume (HV), defined by the Leapfrog Group for Patient Safety, advocate the concentration of high-risk medical care to high-volume hospitals in order to avail of these outcome benefits. We explored the effect of Leapfrog volume thresholds (LVT) on 5 short-term radical cystectomy (RC) outcomes.

Materials and methods: Within the Health Care Utilization Project Nationwide Inpatient Sample, we focused on RCs performed between 2001 and 2007. We tested the rates of in-hospital mortality, intraoperative and postoperative complications, blood transfusions, as well as length of stay, stratified according to the number of LVT met. Multivariable regression analyses further adjusted for potential confounders.

Results: Overall, 28.6%, 17.1%, 18.8%, 17.0%, 15.4%, and 3.1% of cases were performed at institutions reaching 0, 1, 2, 3, 4, and 5 LVT, respectively. Patients treated at institutions reaching 5 LVT had fewer comorbidities, were younger, and more likely to hold private insurance, relative to patients treated at institutions reaching 0 LVT. In adjusted analyses, after accounting for patient characteristics and HV, LVT status was inversely related to mortality ($P = 0.030$), intraoperative ($P = 0.042$) and postoperative ($P = 0.041$) complications, as well as the likelihood of blood transfusion ($P < 0.001$).

Conclusions: LVT is an important determinant of the risk of mortality, complications, and blood transfusions after RC, independent of HV. These findings hint at intrinsic structural and procedural elements available within hospitals that meet LVT, which enable them to manage complications, and prevent mortality, in a more optimal manner. Crown Copyright © 2014 Published by Elsevier Inc. All rights reserved.

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1. Introduction

Hospital volume (HV) and surgeon volume have been shown to be associated with favorable perioperative outcomes after surgery [1], with an inverse relationship between HV and

in-hospital morbidity and mortality, as well as length of stay (LOS) [2–4]. Under this premise, threshold levels for HV, defined by the Leapfrog Group for Patient Safety [5], advocates the concentration of high-risk medical care to high-volume hospitals in order to avail of these outcome benefits.

The mechanisms behind why higher volume hospitals deliver superior outcomes remain unclear. Although there is some evidence that a lower rate of complications may

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represent the underlying cause [6], a growing body of evidence supports the concept of “failure to rescue” (FTR) [7,8]. The latter proposes that while complication rates may be comparable between high-volume and low-volume institutions, high-volume hospitals are better equipped with the know-how and the management of complications in the aftermath (“rescue”), which results in lower in-hospital mortality.

We investigated the effect of Leapfrog volume thresholds (LVT) on perioperative outcomes after radical cystectomy (RC) on a large, contemporary (2001–2007) population-based cohort. The outcomes examined were blood transfusions, intraoperative and postoperative complications, LOS, and in-hospital mortality. We hypothesized that superior health infrastructural components available to high-volume centers delivering complex surgical care, defined by LVT, are closely related to more favorable short-term outcomes after RC, even after adjusting for established predictors such as HV.

2. Patients and methods

2.1. Data source

Data from the Nationwide Inpatient Sample (NIS) were abstracted between years 2001 and 2007. The NIS includes inpatient discharge data collected via federal-state partnerships, as part of the Agency for Healthcare Research and Quality’s Healthcare Cost and Utilization Project. As of the year 2007, the NIS contained administrative data on 8,043,415 discharges from 1,044 hospitals within 40 states, approximating 20% of community hospitals within the United States, including public hospitals and academic medical centers. The NIS is the sole hospital database in the United States with charge information on all patients regardless of payer, including persons covered by Medicare, Medicaid, private insurance, and the uninsured.

2.2. Sample population and surgical procedures

Relying on discharge records, all patients with a primary diagnosis of bladder cancer (International Classification of Diseases-9-Clinical Modification [ICD-9-CM] code 188) were identified. The cystectomy procedure code (ICD-9-CM 57.7) resulted in the identification of 12,274 patients who underwent RC between 2001 and 2007. Hospital sampling weights were used to estimate the total number of these procedures performed in the United States each year, yielding a weighted national estimate of 45,354 RCs over the course of the study.

2.3. Baseline patient and hospital characteristics

Patient attributes examined included age, year of surgery, race (white vs. black vs. other [Asian, Pacific Islander,

Native American, or unspecified] vs. unknown), Charlson comorbidity index, insurance status, and median zip code income. Charlson comorbidity index was derived from ICD-9 codes according to the previously established criteria [9], and was dichotomized as <3 vs. ≥ 3 . With regard to hospital attributes, analyses focused on 2 readily available metrics, namely HV and LVT, rather than specific structural components (e.g., hospital bed size, nursing staffing levels, or teaching affiliation). HV was defined according to the number of procedures performed at each participating institution during each study calendar year.

2.4. LVT

The main predictor of interest was the effect of meeting LVT. The Leapfrog Group has established minimum “evidence-based hospital referral” volume criteria for individual hospitals for each of 5 complex surgical procedures to designate a hospital as meeting the LVT [5]. The cut-offs were: ≥ 450 for coronary artery bypass graft (ICD-9-CM procedure codes of 36.1 \times), ≥ 400 for percutaneous coronary intervention (36.01, 36.02, 36.05, 36.06, and 36.07), ≥ 50 for abdominal aortic aneurysm repair (38.34, 38.44, 38.64, 39.71, and 39.25), ≥ 11 for pancreatotomy (52.51, 52.53, 52.6, and 52.7), and ≥ 13 for esophagectomy (42.4, 42.4 \times , 42.5, 42.5 \times , 42.6, and 42.6 \times). The number of cases performed in a hospital for a given year was calculated by selected patients who were all ≥ 18 years of age and who underwent the procedure of interest in that year (either as primary procedure or any of the secondary procedures). As previously described [10], the number of procedures performed by the hospital per year was calculated, and hospitals meeting the minimum volume criteria in a specific year were designated as a high-volume hospital for that procedure in that year. The LVT status was further categorized into 6 groups: did not meet any LVT or did not perform any Leapfrog-specified procedure (0 LVT) vs. met standards for 1 Leapfrog-specified procedure (1 LVT) and so on up to met standards for all 5 Leapfrog-specified procedures (5 LVT).

2.5. Outcomes

Five endpoints during hospitalization were examined: intraoperative complication, postoperative complication, blood transfusions, LOS, and in-hospital mortality. The NIS records up to 15 diagnoses and procedures per in-hospital stay. The presence of any complication was defined using ICD-9 diagnoses 2 through 15. The specific ICD-9 codes used for complications were previously described [11]. Intraoperative complication was defined as accidental puncture or laceration during a procedure (ICD-9: 998.2). The following groups of postoperative complications were identified: complications occurring in the digestive system, respiratory complications, hemorrhage or hematoma, cardiac-related complications, postoperative infections, vascular complications,

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