Contemporary Rates of Preoperative Cardiac Testing Prior to Inpatient Hip Fracture Surgery

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Hip fracture is a common reason for urgent inpatient surgery. In the past few years, several professional societies have identified preoperative echocardiography and stress testing for noncardiac surgeries as low-value diagnostics. We utilized data on hospitalizations with a primary diagnosis of hip fracture surgery between 2011 and 2015 from the State Inpatient Databases (SID) of Maryland, New Jersey, and Washington, combined with data on hospital characteristics from the American Hospital Association (AHA). We found that the rate of preoperative ischemic testing is surprisingly but encouragingly low (stress tests 1.1% and cardiac catheterizations 0.5%), which is consistent with studies evaluating the outpatient utilization of these tests for low- and intermediate-risk surgeries. The rate of echocardiograms was 12.6%, which was higher than other published reports. Our findings emphasize the importance of ensuring that quality improvement efforts are directed toward areas where quality improvement is, in fact, needed. *Journal of Hospital Medicine* 2019;14:224-228. © 2019 Society of Hospital Medicine

Hip fracture is a common reason for unexpected, urgent inpatient surgery in older patients. In 2005, the incidence of hip fracture was 369.0 and 793.5 per 100,000 in men and women respectively.[1] These numbers declined over the preceding decade, potentially as a result of bisphosphonate use. Age- and risk-adjusted 30-day mortality rates for men and women in 2005 were approximately 10% and 5%, respectively.

Evidence suggests that timely surgical repair of hip fractures improves outcomes, although the optimal timing is controversial. Guidelines from the American College of Surgeons Committee on Trauma from 2015 recommend surgical intervention within 48 hours for geriatric hip fracures.[2] A 2008 systematic review found that operative delay beyond 48 hours was associated with a 41% increase in 30-day all-cause mortality and a 32% increase in one-year all-cause mortality.[3] Recent evidence suggests that the rate of complications begins to increase with delays beyond 24 hours.[4]

There has been a focus over the past decade on overuse of preoperative testing for low- and intermediate-risk surgeries.[5-7] Beginning in 2012, the American Board of Internal Medicine initiated the *Choosing Wisely*® campaign in which numerous societies issued recommendations on reducing utilization of various diagnostic tests, a number of which have focused on preoperative tests. Two groups—the American Society of Anesthesiologists (ASA) and the American Society of Echocardiography (ASE)— issued specific recommendations on preoperative cardiac testing.[8] In February 2013, the ASE recommended avoiding preoperative echocardiograms in patients without a history or symptoms of heart disease. In October 2013, the ASA recommended against transthoracic echocardiogram (TTE), transesophageal echocardiogram (TEE), or stress testing for low- or intermediate-risk noncardiac surgery for patients with stable cardiac disease.

Finally, in 2014, the American College of Cardiology (ACC)/American Heart Association (AHA) issued updated perioperative guidelines for patients undergoing noncardiac surgeries.[9] They recommended preoperative stress testing only in a small subset of cases (patients with an elevated perioperative risk of major adverse cardiac event, a poor or unknown functional capacity, or those in whom stress testing would impact perioperative care).

Given the high cost of preoperative cardiac testing, the potential for delays in care that can adversely impact outcomes, and the recent recommendations, we sought to characterize the rates of inpatient preoperative cardiac testing prior to hip fracture surgery in recent years and to see whether recent recommendations to curb use of these tests were temporally associated with changing rates.

METHODS

Overview

We utilized two datasets—the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) and the American Hospital Association (AHA) Annual Survey—to character-

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ize preoperative cardiac testing. SID data from Maryland, New Jersey, and Washington State from 2011 through September 2015 were used (the ICD coding system changed from ICD9 to ICD10 on October 1, 2015). This was combined with AHA data for these years. We included all hospitalizations with a primary ICD9 procedure code for hip fracture repair—78.55, 78.65, 79.05, 79.15, 79.25, 79.35, 79.45, 79.55, 79.65, 79.75, 79.85, and 79.95. We excluded all observations that involved an interhospital transfer. This study was exempt from institutional review board approval.

Measurement and Outcomes

We summarized demographic data for the hospitalizations that met the inclusion criteria as well as the associated hospitals. The primary outcome was the percentage of patients undergoing TTE, stress test, and cardiac catheterization during a hospitalization with a primary procedure code of hip fracture repair. Random effects logistic regression models for each type of diagnostic test were developed to determine the factors that might impact test utilization. In addition to running each test as a separate model, we also performed an analysis in which the outcome was performance of any of these three cardiac tests. Random effects were used to account for clustering of testing within hospitals. Variables included time (3-month intervals), state, age (continuous variable), gender, length of stay, payer (Medicare/Medicaid/private insurance/self-pay/other), hospital teaching status (major teaching/minor teaching/nonteaching), hospital size according to number of beds (continuous variable), and mortality score. Major teaching hospitals are defined as members of the Council of Teaching Hospitals. Minor teaching hospitals are defined as (1) those with one or more postgraduate training programs recognized by the American Council on Graduate Medical Education, (2) those with a medical school affiliation reported to the American Medical Association, or (3) those with an internship or residency approved by the American Osteopathic Association.

The SID has a specific binary indicator variable for each of the three diagnostic tests we evaluated. The use of the diagnostic test is evaluated through both UB-92 revenue codes and ICD9 procedure codes, with the presence of either leading to the indicator variable being positive.[10] Finally, we performed a sensitivity analysis to evaluate the significance of changing utilization trends by interrupted time series analysis. A level of 0.05 was used to determine statistical significance. Analyses were done in STATA 15 (College Station, Texas).

RESULTS

The dataset included 75,144 hospitalizations with a primary procedure code of hip fracture over the study period (Table). The number of hospitalizations per year was fairly consistent over the study period in each state, although there were fewer hospitalizations for 2015 as this included only January through September. The mean age was 72.8 years, and 67% were female. The primary payer was Medicare for 71.7% of hospitalizations. Hospitalizations occurred at 181 hospitals, the plurality of which (42.9%) were minor teaching hospitals. The proportions of hospitalizations that included a TTE, stress test, and cardiac catheterization were 12.6%, 1.1%, and 0.5%, respectively. Overall, 13.5% of patients underwent any cardiac testing.

There was a statistically significantly lower rate of stress tests (odds ratio [OR], 0.32; 95% CI, 0.19-0.54) and cardiac catheterizations (OR, 0.46; 95% CI, 0.27-0.79) in Washington than in Maryland and New Jersey. Female gender was associated with significantly lower adjusted ORs for stress tests (OR, 0.74; 95% CI, 0.63-0.86) and cardiac catheterizations (OR, 0.73; 95% CI, 0.59-0.91), and increasing age was associated with higher adjusted ORs for each test (TTE, OR, 1.033; 95% CI, 1.031-1.035; stress tests, OR, 1.007; 95% CI, 1.001-1.013; cardiac catheterizations, OR, 1.011; 95% CI, 1.003-1.019). Private insurance was associated with a lower likelihood of stress tests (OR, 0.65; 95% CI, 0.50-0.85) and cardiac catheterizations (OR, 0.67; 95% CI,0.46-0.98), and self-pay was associated with a lower likelihood of TTE (OR, 0.76; 95% CI, 0.61-0.95) and stress test (OR, 0.43; 95% CI, 0.21-0.90), all compared with Medicare.

Larger hospitals were associated with a greater likelihood of cardiac catheterizations (OR, 1.18; 95% CI, 1.03-1.36) and a lower likelihood of TTE (OR, 0.89; 95% CI, 0.82-0.96). An unweighted average of these tests between 2011 and October 2015 showed a modest increase in TTEs and a modest decrease in stress tests and cardiac catheterizations (Figure). A multivariable random effects regression for use of TTEs revealed a significantly increasing trend from 2011 to 2014 (OR, 1.04, $P < .0001$), but the decreasing trend for 2015 was not statistically significant when analyzed according to quarters or months (for which data from only New Jersey and Washington are available).

In the combined model with any cardiac testing as the outcome, the likelihood of testing was lower in Washington (OR, 0.56; 95% CI, 0.31-0.995). Primary payer status of self-pay was associated with a lower likelihood of cardiac testing (OR, 0.73; 95% CI, 0.58-0.90). Female gender was associated with a lower likelihood of testing (OR, 0.93; 95% CI, 0.88-0.98), and high mortality score was associated with a higher likelihood of testing (OR, 1.030; 95% CI, 1.027-1.033). TTEs were the major driver of this model as these were the most heavily utilized test.

DISCUSSION

There has been limited research into how often preoperative cardiac testing occurs in the inpatient setting. Our aim was to study its prevalence prior to hip fracture surgery during a time period when multiple recommendations had been issued to limit its use. We found rates of ischemic testing (stress tests and cardiac catheterizations) to be appropriately, and perhaps surprisingly, low. Our results on ischemic testing rates are consistent with previous studies, which have focused on the outpatient setting where much of the preoperative workup for nonurgent surgeries occurs. The rate of TTEs was higher than in previous studies of the outpatient preoperative setting, although it is unclear what an optimal rate of TTEs is.

A recent study examining outpatient preoperative stress tests within the 30 days before cataract surgeries, knee ar-

TABLE. **Descriptive Statistics, Patient, and Hospital Characteristics**

Overall testing volume, total number (% of patients)				
Echocardiograms	9,441 (12.6)			
Stress tests	801 (1.1)			
Cardiac catheterizations	381 (0.5)			
Patient characteristics	**(n = 75,144 admissions)**			
Age (standard deviation)	72.8 (21.1)			
Gender (female)	67.1%			
Primary payer[a]				
Medicare	53,903	71.7%		
Private insurance	13,753	18.3%		
Medicaid	3,959	5.3%		
Other	1,663	2.2%		
Self-pay	1,613	2.2%		
No charge	248	0.3%		
Hospital characteristics	**(n =75,144 admissions)**		**(n = 181 hospitals)**	
State	Patients		Hospitals[b]	
Maryland	19,283	25.6%	47	26.0%
New Jersey	32,467	43.2%	66	36.5%
Washington	23,394	31.1%	68	37.6%
Bed size[c]				
< 100 beds	4,595	4.5%	48	20.8%
100-199 beds	13,855	18.4%	56	24.2%
200-299 beds	18,185	24.9%	54	23.4%
300-399 beds	12,174	15.8%	34	14.7%
400-499 beds	11,708	16.3%	23	10.0%
> 500 beds	14,487	18.2%	16	6.9%
Teaching status[d]				
Major teaching	15,473	20.6%	21	10.0%
Minor teaching	34,548	46.1%	90	42.9%
Nonteaching	25,002	33.3%	99	47.1%

[a]Missing payer observations by patient = 5

[b]Number of hospitals by bed size and teaching status adds to greater than 181 because of changes in hospital size and teaching status over the study period.

[c]Missing bed size observations = 140

[d]Missing teaching status observations = 121

throscopies, or shoulder arthroscopies found a rate of 2.1% for Medicare fee-for-service patients in 2009 with little regional variation.[11] Another evaluation using 2009 Medicare claims data found rates of preoperative TTEs and stress tests to be 0.8% and 0.7%, respectively.[12] They included TTEs and stress tests performed within 30 days of a low- or intermediate-risk surgery. A study analyzing the rate of preoperative TTEs between 2009 and 2014 found that rates varied from 2.0% to 3.4% for commercially insured patients aged 50-64 years and Medicare-advantage patients, respectively, in 2009.[13] These rates decreased by 7.0% and 12.6% from 2009 to 2014. These studies, like ours, suggest that preoperative cardiac testing has not been a major source of wasteful spending. One explanation for the higher rate of TTEs we observed in the inpatient setting might be that primary care physicians in the outpatient setting are more likely to have historical cardiac testing results compared with physicians in a hospital.

We found that the rate of stress testing and cardiac catheterization in Washington was significantly lower than that in Maryland and New Jersey. This is consistent with a number of measures of healthcare utilization – total Medicare reimbursement in the last six months of life, mean number of hospital days in the last six months of life, and healthcare intensity index—for all of which Washington was below the national mean and Maryland and New Jersey were above it.[14]

Finally, we found evidence of a lower rate of preoperative

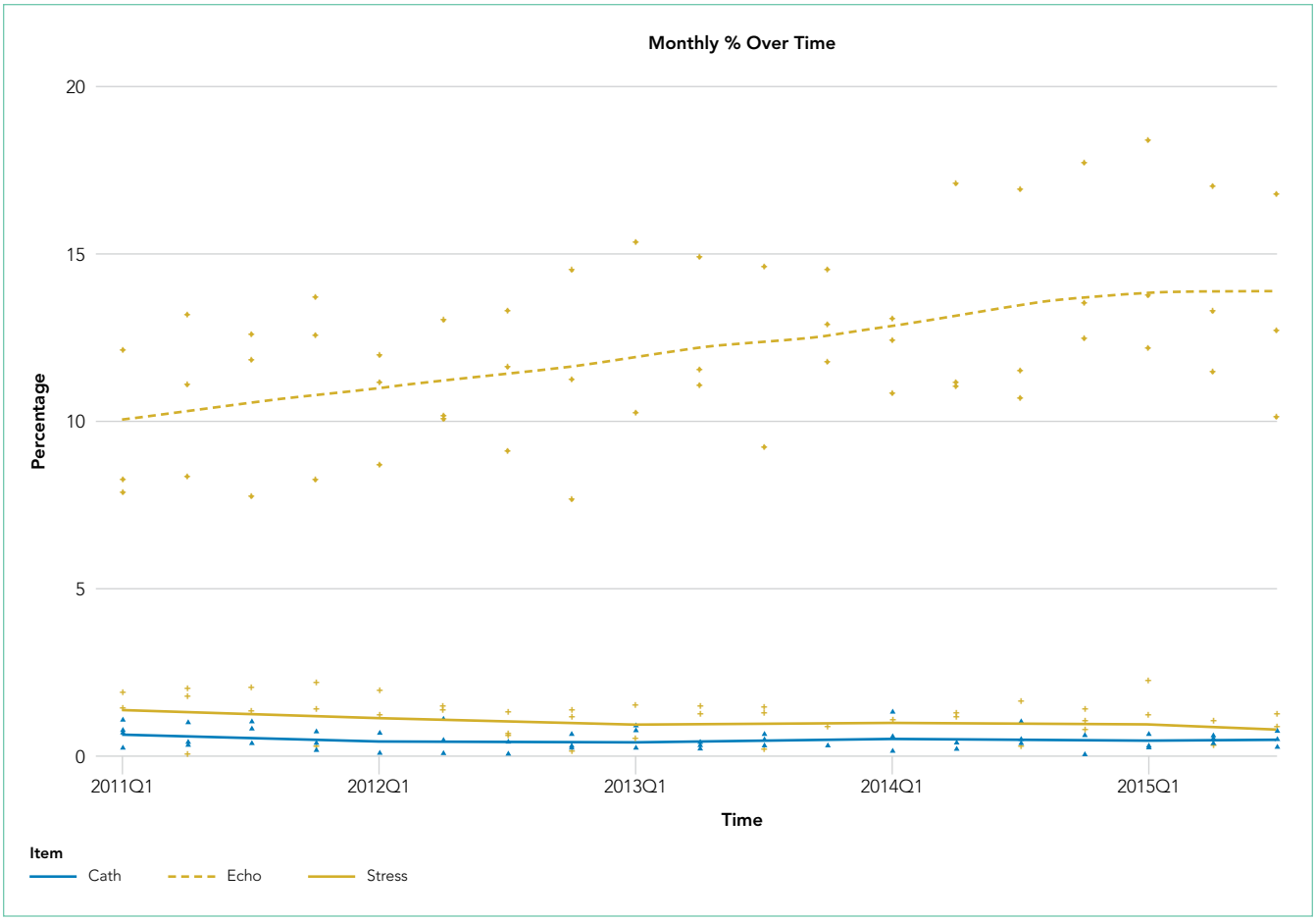

FIG. Unweighted total transthoracic echocardiograms, stress tests, and cardiac catheterizations over time

stress tests and cardiac catheterizations for women despite controlling for age and mortality score. Of course, we did not control directly for cardiovascular comorbidities; as a result, there could be residual confounding. However, these results are consistent with previous findings of gender bias in both pharmacologic management of coronary artery disease (CAD)[15] and diagnostic testing for suspected CAD.[16]

We focused on hospitalizations with a primary procedure code to surgically treat hip fracture. We are unable to tell if the cardiac testing of these patients had occurred before or after the procedure. However, we suspect that the vast majority were completed for preoperative evaluation. It is likely that a small subset were done to diagnose and manage cardiac complications that either accompanied the hip fracture or occurred postoperatively. Another limitation is that we cannot determine if a patient had one of these tests recently in the emergency department or as an outpatient.

We also chose to include only patients who actually had hip fracture surgery. It is possible that the testing rate is higher for all patients admitted for hip fracture and that some of these patients did not have surgery because of abnormal cardiac testing. However, we suspect that this is a very small fraction given the high degree of morbidity and mortality associated with untreated hip fracture.

CONCLUSION

We found a low rate of preoperative cardiac testing in patients hospitalized for hip fracture surgery both in the years before and after the issuance of recommendations intended to curb its use. Although it is reassuring that the volume of low-value testing is lower than we expected, these findings highlight the importance of targeting utilization improvement efforts toward low-value tests and procedures that are more heavily used, since further curbing the use of infrequently utilized tests and procedures will have only a modest impact on overall healthcare expenditure. Our findings highlight the necessity that professional organizations ensure that they focus on true areas of inappropriate utilization. These are the areas in which improvements will have a major impact on healthcare spending. Further research should aim to quantify unwarranted cardiac testing for other inpatient surgeries that are less urgent, as the urgency of hip fracture repair may be driving the relatively low utilization of inpatient cardiac testing.

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