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Cost conscious care: preoperative evaluation by a cardiologist prior to low-risk procedures

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ABSTRACT

Background Preoperative testing before low-risk procedures remains overutilised. Few studies have looked at factors leading to increased testing. We hypothesised that consultation to a cardiologist prior to a low-risk procedure leads to increased cardiac testing.

Methods and results 907 consecutive patients who underwent inpatient endoscopy/colonoscopy at a single academic centre were identified. Of those patients, 79 patients (8.7%) received preoperative consultation from a board certified cardiologist. 158 control patients who did not receive consultation from a cardiologist were matched by age and gender. Clinical and financial data were obtained from chart review and hospital billing. Logistic and linear regression models were constructed to compare the groups. Patients evaluated by a cardiologist were more likely to receive preoperative testing than patients who did not undergo evaluation with a cardiologist (OR 47.5, (95% CI 6.49 to 347.65). Specifically, patients seen by a cardiologist received more echocardiograms (60.8% vs 22.2%, p<0.0001) and 12-lead electrocardiograms (98.7% vs 54.4%, p<0.0001). There was a higher rate of ischaemic evaluations in the group evaluated by a cardiologist, but those differences did not achieve statistical significance. Testing led to longer length of stay (4.35 vs 3.46 days, p=0.0032) in the cohort evaluated by a cardiologist driven primarily by delay to procedure of 0.76 days (3.14 vs 2.38 days, p=0.001). Estimated costs resulting from the longer length of stay and increased testing was $10 624 per patient. There were zero major adverse cardiac events in either group.

Conclusion Preoperative consultation to a cardiologist before a low-risk procedure is associated with more preoperative testing. This preoperative testing increases length of stay and cost without affecting outcomes.

INTRODUCTION

Cardiac risk assessments or preoperative risk evaluations are often performed prior to both surgical and non-surgical procedures. These assessments are performed by cardiologists as well as non-specialists. Despite current guidelines that provide algorithms for preoperative testing, the efficacy of these evaluations is unclear. Multiple reports have demonstrated overutilisation of preoperative testing,[1–6] yet few studies have compared the utilisation of preoperative testing and outcomes between cardiologists and non-specialists. Recent data have suggested that consultation with a cardiologist for preoperative evaluation before intermediate-risk surgery does not affect adverse cardiovascular event rates.[7] We sought to measure the effect of obtaining cardiology consultation for preoperative evaluation prior to a low-risk procedure on the volume of tests ordered and cost.

Hypothesis

Preoperative consultation with a cardiologist for cardiac risk assessment prior to a low-risk procedure results in increased testing and increased cost.

METHODS

Study population

The study protocol was approved by the Institutional Review Board of the University of South Florida and Tampa General Hospital. Patients were selected on the basis of an inpatient clinical encounter in which a billing diagnosis code for an endoscopic procedure was recorded (CPT: 43 235–43259, 44 388–44392, 44394, 45355, 45 378–45380, 45382, 45384, 45385). A total of 907 consecutive patients scheduled to undergo inpatient endoscopy or colonoscopy at a single academic tertiary referral centre from 1 November 2011 and 31 April 2016 were identified. We chose to examine patients undergoing endoscopy because most of the endoscopy in our institution is performed by gastroenterologists who are board-certified in internal medicine. Preoperative evaluation is thus within the scope of their practice. Of those patients, 79 patients (8.7%) underwent preoperative cardiac evaluation by a board certified cardiologist and represented the cases for this study. A total of 158 control patients who did not undergo preoperative cardiac evaluation with a cardiologist were matched by age and gender to cases in a 2:1 ratio. The primary outcome was the number of tests ordered;

the secondary outcomes were cost and lengths of stay. We reviewed 5 years of patients to generate a convenience sample of patients seen by a cardiologist. To increase the likelihood of detecting differences in our selected outcomes, a 2:1 control sample was selected.

Outcome measurements

Complete demographic and clinical characteristics were recorded through individual chart review. Tests ordered for each group were obtained through the retrospective chart review. The cost was determined by reviewing accessible information provided in hospital billing statements and calculating charges for each test ordered as well as for the hospitalisation. These charges were then converted to cost to the healthcare system by using the average cost-to-charge ratio for the state of Florida from the Healthcare Utilization Project Database.[8]

Statistical analysis

Patient demographic and medical history were compared using the χ^2 and Fisher's exact tests for categorical variables and t-tests for continuous variables after normality of distribution were confirmed using the Shapiro-Wilks test. Logistic regression models were built to assess the difference in the receipt of preoperative cardiac testing based on baseline clinical and demographic characteristics. Multiple logistic regression models assessing the difference in preoperative cardiac testing between the two groups were also fitted using the following variables: HTN, CAD, HLD, DM II, CHF, smoking history, AF, anticoagulation, age and valvular disease—none of which were statistically significant. Student's t-test was used to assess the difference in the average length of stay between the two groups. The statistical computation was done using SAS V.9.4. A p value of <0.05 was considered statistically significant.

RESULTS

Patients who were evaluated by a cardiologist were more likely to have coronary artery disease (OR 3.82, p<0.0001), hypertension (OR 1.97, p=0.0195) and hyperlipidaemia (OR 1.97, p=0.0265) than patients who did not receive preoperative consultation with a cardiologist. There were no other significant differences in terms of comorbidities between the two groups. Baseline characteristics are listed in table 1.

Preoperative cardiac testing was more common in patients evaluated by a cardiologist versus patients who did not receive preoperative consultation with a cardiologist (OR 47.5, 95% CI 6.49 to 347.65). Multiple logistic regression models assessing the association between preoperative cardiac testing and consultation were performed with adjustments for medical history of hypertension (p=0.2), coronary artery disease (p=0.9), hyperlipidaemia (p=0.6), diabetes mellitus II (p=0.6), congestive heart failure (p=0.9), smoking (p=0.6), atrial fibrillation (p=0.2), valvular disease (p=0.9) and anticoagulant usage (p=0.9), none of which were statistically significant. However, patients who were evaluated by a cardiologist prior to a low-risk procedure received more echocardiograms (60.8% vs 22.2%, p<0.0001) and 12-lead electrocardiograms (98.7% vs 54.4%, p<0.0001). There was no statistically significant difference in the rate of nuclear stress tests (21.5% vs 14.6%, p=0.1774), coronary CT angiograms (2.5% vs 0%, p=0.1102) and cardiac catheterisations (1.3% vs 0%, p=0.3333) in the patients evaluated by a cardiologist compared with patients who proceeded directly to endoscopy. These results are listed in table 2.

Patients who were evaluated by a cardiologist prior to endoscopy or colonoscopy had a longer length of stay in the hospital (4.35 vs 3.46 days, p=0.0032). Evaluation

Table 1 Baseline patient characteristics

Characteristic No. (%)	With cardiology consultation % (n=79)	Without cardiology consultation % (n=158)	RR (95% CI)	P value
Age (years)	56.10	56.02		0.9503
Gender				
Male	43 (34)	43 (68)	1.00 (0.73 to 1.36)	0.9999
Female	57 (45)	57 (90)	1.00 (0.79 to 1.26)	
Hypertension	69.6 (55)	53.8 (85)	1.29 (1.05 to 1.59)	0.0195
Diabetes mellitus	36.7 (29)	25.9 (41)	1.41 (0.96 to 2.09)	0.0870
Coronary artery disease	32.9 (26)	11.4 (18)	2.89 (1.69 to 4.94)	<0.0001
Hyperlipidaemia	34.2 (27)	20.9 (33)	1.63 (1.06 to 2.52)	0.0265
Congestive heart failure	6.3 (5)	4.4 (7)	1.43 (0.47 to 4.36)	0.5297
History of smoking	32.9 (26)	28.5 (45)	1.16 (0.77 to 1.72)	0.4827
Atrial fibrillation	5.1 (4)	4.4 (7)	1.14 (0.34 to 3.79)	0.8272
Valvular disease	5.1 (4)	3.2 (5)	1.60 (0.44 to 5.79)	0.4860
Anticoagulation	2.5 (2)	0.6 (1)	4.00 (0.37 to 43.45)	0.2583

RR, relative risk.

Table 2 Tests ordered in patients with and without cardiology consultation

Differences in testing	With cardiology consultation n=79	Without cardiology consultation n=158	RR (95% CI)	P value
Tests obtained	% (No)			
ECG	98.7 (78)	54.4 (86)	1.81 (1.57 to 2.10)	<0.0001
Transthoracic echocardiogram	60.8 (48)	22.2 (35)	2.74 (1.95 to 3.86)	<0.0001
Nuclear stress imaging	21.5 (17)	14.6 (23)	1.48 (0.84 to 2.60)	0.1774
CT coronary arteries	2.5 (2)	0 (0)	–	0.1102
Cardiac catheterisation	1.3 (1)	0 (0)	–	0.3333

RR, relative risk.

by a cardiologist was also strongly associated with delay to endoscopy of 0.76 days (3.14 vs 2.38 days, admission to endoscopy with and without cardiology consultation, p=0.001). There were no differences in major adverse cardiac events or mortality between the two groups (table 3).

The combination of the length of stay and increased testing had a substantial effect on cost. Evaluation by a board-certified cardiologist led to increased estimated charges of $839 332. After adjustment of charges to average cost, consultation with a cardiologist resulted in an average estimated increase in the cost of $10 624 per patient. These results are listed in table 4.

DISCUSSION

Main findings

Our results demonstrate three main findings: first, preoperative consultation to a board-certified cardiologist prior to low-risk procedures is frequent; second, consultation to a cardiologist is associated with increased cardiac testing despite guideline recommendations that advise against additional testing; and third, preoperative consultation to a cardiologist prior to low-risk procedures significantly increases length of stay.

Although multiple reports have documented the high prevalence of preoperative testing prior to low-risk procedures,[9 10] our study is one of the first to our knowledge to suggest that consultation specifically to a cardiologist led to increased use of low-yield preoperative testing. Cardiologists also tend to order testing that is more cardiac specific. In particular, our data demonstrate a much higher rate of echocardiograms (ultrasounds of the heart) and suggest that there may be a higher rate of cardiac ischaemic evaluations such as stress tests. Echocardiograms detail cardiac structure and function, and they are often the first test used to assess ejection fraction. For a patient about to undergo a low-risk procedure like endoscopy, the echocardiogram rarely changes management or affects outcomes even if a patient is discovered to have structural heart disease; hence, the value of an echocardiogram in this setting is fairly low. Stress tests help establish either the presence of coronary artery disease or the burden of coronary artery disease for patients with known disease. There has been abundant recent evidence that revascularisation of coronary artery stenosis prior to high-risk surgery like vascular surgery does not affect outcomes.[11] Thus, testing for cardiac ischaemia prior to endoscopy is rarely indicated as positive or negative tests usually lead to a recommendation to proceed with the surgery or procedure. Our data are limited in that we could not assess specific reasons for consulting a board-certified cardiologist for preoperative evaluation. That said, the act of consultation itself might be viewed as a form of triage, and so it may be reasonable to speculate that testing is ordered because of a presumption of a more acute issue in a patient's clinical condition even though our data suggest that such testing does not have a major effect on outcomes.

Our data could not measure other motivations such as the pressures of defensive medicine. Further research looking at the variation of resource utilisation according to metrics related to medical malpractice might be useful in shedding light on this issue. Alternatively, it may simply be that our data reflect the ongoing vestiges of a fee-for-service system, and thus, it would remain unsurprising that consultation to a specialist

Table 3 Hospital-associated outcomes

	With cardiology consultation n=79	Without cardiology consultation n=158	95% CI	P value
Average time from admission to endoscopy (days) (mean)	3.14±2.09	2.38±1.40	−1.21 to −0.31	0.0010
Average length of stay (days) (mean)	4.35±2.82	3.46±1.79	−1.49 to −0.30	0.0032
Adverse cardiac events	0	0	–	–

Table 4 Economic impact of preoperative cardiology consultation

	Charge	Cost	With cardiology consultation: Total number, n=79	With cardiology consultation: Total cost	Without cardiology consultation: Total number, n=158	Without cardiology consultation: Total cost	Adjusted cost 1:1 ratio	Cost differential
Tests obtained			No. (%)		No. (%)			
ECG	$452	$125	78 (98.7)	$9750	86 (54.4)	$10750	$5375	$4375
Transthoracic echo	$4490	$1239	48 (60.8)	$59483	35 (22.2)	$43366	$21683	$37800
Nuclear stress imaging	$9551	$2636	17 (21.5)	$44812	23 (14.6)	$60628	$30314	$14498
CT coronary arteries	$3177	$877	2 (2.5)	$1754	0 (0)	$0	$0	$1754
Left heart catheterisation	$26597	$7341	1 (1.3)	$7341	0 (0)	$0	$0	$7341
Length of stay (days)	$8549	$2360	343.7 days	$811132	546.6 days	$1 289 976	$644988	$166144
Total cost				$934272		$1 404 720	$702360	$231912
Total cost per patient				$11826			$8891	$2935

on routine questions will generate additional services rendered.

We specifically chose to assess preoperative consultation prior to endoscopy as the majority of endoscopic procedures in our institution are performed by gastroenterologists who are also board certified in internal medicine because preoperative consultation is within the scope of their practice as opposed to low-risk procedures such as cataract surgery or cystoscopy in which the surgeons performing the procedure may be less familiar with preoperative risk stratification. Further research on consultation to a cardiologist prior to those types of low-risk surgeries may result in even more significant findings.

Limitations

There are multiple limitations to our study. First, our study population was small and was likely underpowered to detect differences in clinical outcomes or complications. Larger series have demonstrated that there is no difference in cardiac outcomes or adverse events among patients evaluated by a cardiologist prior to intermediate-risk surgery,[7] so it seems likely that there would be little difference in outcomes or adverse events after a low-risk procedure like endoscopy if our patient cohort had been larger. Future studies with larger populations would be helpful. Our data are intended to be hypothesis generating although we believe that larger cohorts would likely show the same conclusions.

In addition, our study was also underpowered to detect differences in evaluations for cardiac ischaemia. However, the difference in rates of preoperative testing by patients between the two groups was very large, so we speculate that this may represent a signal that consultation to a cardiologist leads to increased testing. Studies on larger cohorts might shed more light on this issue.

Second, our study population was drawn from a single, large, academic tertiary referral centre and may not be generalisable to other healthcare systems. The rate of consultation for preoperative evaluation prior to endoscopic procedures was close to 10%, which may not be representative of other systems. However, in light of the high rates of preoperative testing prior to low-risk surgeries in general, we suspect that our data remain relevant outside of our institution and suggest a possible cause for high rates of preoperative testing seen in other healthcare systems. Indeed, our data might represent an underestimation of resource overutilisation compared with hospitals and other health systems in the general community. Third, as a retrospective analysis, it is subject to the limitations and confounding of all retrospective reviews. By matching cases to controls, the two groups were fairly similar; although there were more patients with coronary artery disease, hypertension and hyperlipidaemia who were seen by a cardiologist, there were no differences in important comorbidities such as valvular disease or atrial fibrillation. Moreover, we could not identify any baseline clinical or demographic characteristic

associated with higher rates of preoperative testing. Finally, our study was limited to the documentation in the medical record, so we could not assess reasons for consultation to a cardiologist.

CONCLUSION

Our data indicate that preoperative consultation to a cardiologist is associated with more preoperative testing. This preoperative testing increases the length of stay and cost. Future studies on the value of consultation to a cardiologist prior to low-risk procedures are warranted.

Contributors JC: performed the primary data collection and analysis and wrote the primary draft of the manuscript. TT: performed statistical analysis of the data. TQ: performed statistical review of the data. MSB: reviewed and edited the final manuscript. SHC: planned the study, wrote the final draft of the manuscript and submitted the study; responsible for the overall content of the manuscript.

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