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Original Article

Diagnostic yield and costs associated with a routine pre-operative COVID-19 testing algorithm for asymptomatic patients prior to elective surgery

Michael E Mawhorter[1], Paul Nguyen[1], Mackenzie Goldsmith[1], Russell Grant Owens[1,2], Blake Baer[1], Jay D Raman[1]

[1]*Department of Urology, Penn State Health Milton S. Hershey Medical Center, Hershey, PA, USA;* [2]*Department of Urology, University of Iowa, Iowa, IA, USA*

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Abstract: Objectives: Infection with COVID-19 presents known and unknown perioperative risks to the patient and operative staff. Pre-operative testing protocols have become widespread, yet little is known about the utility of this practice in asymptomatic patients undergoing elective surgery. We describe the impact and cost of a routine testing protocol on elective surgical procedures in a retrospective series at a single institution. Methods: Standardized pre-operative COVID-19 testing in all surgical patients was implemented in May 2020. Health system protocol required testing 3 to 5 days before all elective surgery. Data stratified by surgical specialty were collected over the initial 90-day period and disposition over a period of 6-months was assessed for all positive and indeterminate results. Results: Thirty-one (0.41%) positive results amongst 7579 pre-procedural tests, including 3 of 792 (0.38%) for urologic procedures, were noted in asymptomatic patients. Following a positive test, 20 procedures (62.5%) were delayed an average of 49 days, 8 were not performed and 3 proceeded without delay. All 3 urologic procedures were delayed a mean of 59 days. Institutional cost per test ranged from $34-$54. The number needed to test for one positive result was 244 with a cost of $11,573 for each positive result. Conclusions: Institution of a universal pre-operative COVID-19 screening protocol for asymptomatic, unvaccinated patients undergoing elective surgery identified clinically silent infection in 0.4% of cases with a significant associated cost. Risk and symptom-based testing is likely a better strategy for triaging resources.

Keywords: Cost, clinical protocols, surgery

Introduction

In March of 2020, the advent of the first confirmed cases of SARS-CoV-2 (COVID-19) in the United States resulted in the almost universal halt of elective surgeries in hospitals nationwide. During these early days, government orders and hospital policy were primarily enacted to ration personal protective equipment (PPE), minimize unnecessary patient or healthcare worker (HCW) exposure to COVID-19, and to conserve hospital resources for the already-rising need by COVID-19 patients [1]. In part, this was due to the unclear but concerning data emerging from international hotspots, primarily Wuhan, China, indicating the high rates (44%) of nosocomial transmission of the virus [2]. In addition, other preliminary data emerged which clearly showed increased risk of complications in COVID-19 positive patients who underwent surgical procedures [3-5].

As the first wave seemed to dissipate, hospitals began to reopen for elective procedures in accordance with the state regulations, in a hospital-by-hospital basis. In seeking to minimize nosocomial transmission to patient and HCW alike and optimize surgical outcomes, hospitals implemented pre-operational testing strategies to screen for COVID-19. The dearth of knowledge about COVID-19 and variations in testing capacity led to differences in pre-operational testing protocols, many of which have been published [3, 6, 7].

In seeking to address these uncertainties, the American College of Surgeons on March 17, 2020, issued guidelines ideally to universally test every patient for COVID-19 prior to a procedure, but made exception based on a hospital's availability of tests, the prevalence of virus in local community, and on the hospital's capacity to manage patients who may be falsely ne-

Table 1. Pre-operative COVID-19 PCR testing and distribution

		All surgeries	Urologic surgeries
Testing	All tests	7579	792
	Positive	31 (0.4%)	3 (0.4%)
	Negative	7548 (99.6%)	789 (99.6%)
Disposition	Proceeded	3 (9.7%)	3 (100%)
	Delayed temporarily	20 (64.5%)	-
	Delayed indefinitely	8 (25.8%)	-

gative [https://www.facs.org/covid-19/clinical-guidance/triage]. Since then, its impact on minimizing nosocomial transmission has been well studied [1, 7-9], but there has not been much evidence of the efficiency and cost of routine pre-operative testing, especially in a rural tertiary care setting.

As the COVID-19 pandemic continues two-years later with high transmission rates and community positivity rates, the merits and value of routine testing of asymptomatic patients prior to elective surgery remains germane in surgical practice. Therefore, we describe the impact of a routine testing protocol on the disposition of surgeries in a rural academic hospital, as well as use costs of preoperative testing as a measure of efficient utility.

Material and methods

This study was performed via retrospective chart review at a single rural academic institution following implementation of routine pre-operative COVID-19 testing. In the setting of a novel respiratory viral pandemic, routine testing in our institution was mandated in an effort to mitigate potential adverse outcomes of anesthetic exposure in unknown COVID infection. Health system protocols required testing 3 to 5 days prior to elective surgical procedures with universal nasopharyngeal swab SARS-COV-2 (COVID-19) PCR. Asymptomatic patients undergoing elective surgery between May 1, 2020 and July 10, 2020 were identified by their procedure date, and were subsequently stratified by surgical division. All cases lacking COVID-19 PCR data and cases with indeterminate results were excluded. Disposition (i.e. proceeded with surgery, surgery temporarily postponed or surgery indefinitely postponed) as well as the time to delayed surgery date were assessed for all positive results over a follow up period of 6-months. These metrics were assessed by descriptive statistical analysis. No control was available for comparison given the emergency application of universal testing.

Financial costs of pre-operative testing were calculated using the institution's chargemaster and ranged between $34 and $54 depending on the date used and the type of pre-operative test. Number needed to test and cost per positive test were determined from positivity rates and aggregate costs for the testing cohort. Descriptive statistical analysis was employed to assess impact.

Results

Over the study interval, 7579 pre-procedural COVID-19 tests were performed in asymptomatic patients undergoing elective surgical procedures (**Table 1**). The symptom verification occurred via a standardized questionnaire encompassing exposures and symptoms collected at the time of the testing. Overall, 31 of 7579 (0.41%) pre-procedural tests were positive for COVID-19, including 3 of 792 (0.38%) urological procedures.

Following a positive test, 20 procedures (62.5%) were delayed an average of 49 days, 8 were not performed and 3 proceeded without delay. All three urologic procedures were in the pediatric urology patient population and were delayed a mean of 59 days. For the 23 surgical procedures performed (20 delayed, 3 without delay), there were no adverse outcomes noted included prolonged hospital duration, readmission, or mortality events.

Hospital chargemaster data provided cost per test ranging from $34-$54. The number of asymptomatic patients needed to test for one positive result was 244 with an associated cost of $11,573 for each positive result.

Discussion

As the COVID-19 pandemic continues, the question of pre-procedure testing remains salient [11]. Clearly, early experience in 2020 highlighted the potential deleterious impact of anesthesia and surgical procedures in patients actively infected or symptomatic with a COVID-19 related infection [1, 3, 4, 11]. In the symptomatic population it is frankly easier to rationalize a testing strategy, develop a timeframe for appropriate intervention, and subsequently execute this algorithm. A greater challenge to reconcile, however, is the asymptomatic patient population undergoing elective surgery. Indeed, this cohort represents the majority of surgical procedures in most hospitals and ambulatory surgical facilities [12].

We understand the potential benefits of screening this asymptomatic patient population. This includes (but is not limited to) identification of "silent" infections, potentially decreasing the risk of surgical or anesthetic complications, obviating exposures to health care workers and/or ancillary hospital staff, and potentially limiting transmission at a population level [13]. Nonetheless, in our experience of testing over 7,500 asymptomatic patients undergoing elective surgical procedures, the overall rate of positivity was less than 0.5%. In other words, almost 250 asymptomatic patients required testing to identify one positive test. Furthermore, analysis within specific surgical domains highlighted that our urologic surgery numbers (0.38%) were commiserate with these overall numbers. Our data are similar to (albeit slightly higher) those reported by Singer and colleagues who noted a prevalence rate of 0.19% of COVID-19 infection in asymptomatic pre-operative patients [1].

The low test-positivity raises some questions pertaining to ubiquitous use in asymptomatic patients prior to elective procedures. Notably, testing in environments with lower prevalence likely identifies proportionally few cases and diverts valuable time and resources [14]. Additionally, the tests themselves have inherent limitations (sensitivity and specificity ~90%) and therefore the risk of false negatives or false positives [6, 15]. Positive tests in recovering individuals or false positive tests in turn may trigger unnecessary contact tracing and quarantine with further waste of resources [8]. Furthermore, cost considerations remain paramount. Here, we noted an estimated associated cost of $11,573 for each positive result. We understand that one cannot look at this in a vacuum and recognize the corollary of health care costs associated with an adverse outcome from a COVID-19 related surgical complication [16]. Indeed, the more significant point is to understand that a more nuanced testing algorithm that focuses on specific higher risk patient populations may enhance the test yield and therefore blunt the cost per positive test [14, 17]. The authors advise targeting populations with highest positivity rates as well as those at highest risk of adverse outcomes for testing in order to maximize benefit. One must also weigh the cost to the many patients who have shouldered the burden of coordinating tests against the potentially devastating nature of even a single preventable adverse outcome.

We acknowledge some limitations of our analysis. Notably, this study encompassed a certain cross-section of time and therefore the observations and conclusions may be based on factors specific for that time-period. Additionally, this experience is specific to a large, rural tertiary health care system and may not be entirely concordant with experience from a different practice environment. Finally, the cost analysis is based on test kit assays and costs used within our health system at that time. Further research focused on different geographic locations and within different eras of the pandemic would be useful to assess the applicability of these data.

Nonetheless, as the COVID-19 pandemic continues, and numbers continue to oscillate temporally and geographically, it is clear that many considerations that clinicians faced almost two years ago are relevant in today's practice environment.

Conclusion

Routine screening for COVID-19 in asymptomatic patients undergoing elective surgery had positivity rate of < 0.5% with significant associated cost. Decisions pertaining to pre-procedure testing protocols should be predicated on risk and symptom stratification while factoring in the local environment.

Disclosure of conflict of interest

None.

Address correspondence to: Jay D Raman, Department of Urology, Penn State Health Milton S. Hershey Medical Center, Hershey, PA, USA. E-mail: jraman@pennstatehealth.psu.edu

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