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Patient Factors and Their Effect on Operating Room Time for Urologic Procedures

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Abstract: Introduction: We examined three patient characteristics: body mass index (BMI), the American Society of Anesthesiologists (ASA) status, and pre-admission testing (PAT), and their effect on total operating room (OR) time for six urologic procedures, including ureteroscopy, transurethral resection of the prostate (TURP), transurethral resection of bladder tumor (TURBT), prostatectomy, nephrectomy, and kidney transplants. Methods: We investigated the effect of these patient factors on OR time using linear regression for urologic procedures from The University of Toledo Medical Center from 2015 to 2020. Results: An increase in BMI was found to correlate with a statistically significant increase in total OR time for ureteroscopy, prostatectomy, and kidney transplant. The PAT showed a decrease in OR time for TURBT cases and an increase for kidney transplant cases. We found no correlation between the ASA status and changes in the total OR time. Conclusions: A higher BMI significantly increases the total OR time for robotic-assisted prostatectomy and kidney transplant but has a minimal effect on endoscopic procedures. Our results do not support ASA status as a predictor of total OR time. Due to the lack of consistency in results for PAT for the different procedures analyzed, further exploration of the effect of this patient factor on OR efficiency is needed.

Keywords: body mass index; American Society of Anesthesiologists classification; pre-admission testing

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1. Introduction

As surgical care accounts for nearly one-third of all US healthcare spendings, and surgery departments in hospitals may account for one-third or more of hospital revenue, surgical operational performance is directly reflected through financial performance [1,2]. A study of hospitals in California found that the average cost for every minute within the operating room (OR) was USD 37, highlighting that the largest potential for cost reduction is through surgical means [1,3]. It was found that wasting a minute in the OR can cost upward of USD 100 per minute based on case complexity [4]. Factors such as scheduling delays, case cancellations, and increased operational duration can all have a negative impact on the efficiency and productivity of the OR and therefore the financial performance of the hospital system. However, research that addresses the factors that enhance or inhibit OR productivity during urologic procedures is scarce.

Here, our goal was to identify factors that enhance productivity and affect efficiency in the operating room. In this study, we examined the effects of three patient characteristics: body mass index (BMI), the American Society of Anesthesiologists (ASA) status, and pre-admission testing (PAT) on six urologic procedures, including ureteroscopy, transurethral

resection of the prostate (TURP), and transurethral resection of bladder tumor (TURBT), prostatectomy, nephrectomy, and kidney transplants.

Obesity is defined as having a BMI $\geq$ 30 kg/m^2 that currently afflicts over 40% of the adult population in the US [5]. BMI is categorized into multiple ranges, with a BMI less than 18.5 considered underweight, a BMI of 18.5 to 25 considered healthy, and a BMI of 25 to 30 considered overweight. Obesity is subdivided into categories as well, with a BMI of 30 to 35 considered Class I obesity, a BMI of 35 to 40 considered Class II obesity, and a BMI of 40 or higher considered Class III obesity. Estimates predict that the prevalence of obesity may rise to nearly 50% by the year 2030 [6]. Obesity also significantly increases the risk of developing many diseases which include hypertension, type 2 diabetes mellitus, fatty liver disease, and even some cancers [7]. Surgeons may be reluctant to operate on obese patients due to technical difficulties and higher rates of complication within this population. In one study, morbid obesity was associated with a significant increase in the overall time to perform total hip arthroplasty [8].

The American Society of Anesthesiologists (ASA) status is a simple classification system that is used to allow for the preoperative health and risk status of surgical patients to be summarized and compared [9]. The ASA status classification has been found to be strongly correlated with outcomes, either independently or in conjunction with other information [10–12]. Classification ranges from I to VI from a healthy patient to a patient who is a brain-dead organ donor [9]. There are a lack of studies analyzing the effect of the ASA status on operating room time specifically for urologic procedures.

Pre-admission testing (PAT) looks to identify the risk factors with increased intra- and postoperative complications in patients [13]. Services can include blood tests, EKGs, medication screening, medication review, and health evaluation. PAT by the anesthesiology team before surgery prevents unnecessary investigation and consultations that can potentially delay or cancel surgeries and has been found to increase efficiency in the OR and financially benefit hospitals [14]. Patients with a higher ASA status benefit from PAT testing for work-up due to the added complexity in their intraoperative care.

We hypothesize that an increase in BMI, ASA status, and use of pre-admission testing will correlate with an increase in OR time. Analyzing and discovering factors that influence operating room time may help reduce turnover time and lead to improved efficiency in the OR, benefiting the hospital, staff, and patients alike.

2. Methods

2.1. Participation Identification and Data Collection

In this cross-sectional study, after the IRB approval (UT IRB #200802) was obtained, we retrospectively reviewed patient records to identify urologic procedures performed at the University of Toledo Medical Center from 2015 to 2020. BMI, ASA status, and PAT, as well as total operating room time were recorded for all procedures. Patient demographic and clinical information was collected from electronic medical records. The data collected include case procedure type, the surgeon who performed the procedure, total operating room time, whether the patient underwent pre-admission testing, the ASA status of the patient, and the patient's BMI. Any case type where less than 5 surgeries were performed by a surgeon or if the surgeon had less than 3 months of available data were excluded. Cases that did not have a reported BMI, PAT, or ASA status were not included. Only robotic-assisted prostatectomy cases were included as the number of cases that utilized other prostatectomy methods was low ($n < 30$). The total operating room time was defined as the time between patient entry into the OR and patient exit from the OR. The sample size was limited to available cases at this medical center meeting the inclusion criteria.

2.2. Statistical Analysis

Descriptive statistics were calculated using N, percentages, medians, interquartile ranges, means, and standard deviations where appropriate. The OR time was log-transformed to meet the normality assumption. We used multiple linear regression to examine the potential

predictors of the log OR time. IBM SPSS Statistics Version 28.0.1.1 software was used for all analyses. We considered the following variables as the potential predictors for the log OR time: BMI, ASA status, and PAT. BMI was categorized into six categories. Underweight contained any cases with a BMI under 18.5. Overweight contained cases with a BMI between 25 and 30. Obesity Class I included BMIs between 30 and 35, Class II included BMIs between 35 and 40, and Class III included BMIs 40 or higher. Healthy weight range (BMI between 18.5 and 25) was considered the reference category. Each ASA class was compared to the lowest ASA class available for each procedure. A *p*-value less than 0.05 was considered statistically significant.

3. Results

A total of 316 ureteroscopies, 146 TURPs, 182 TURBTs, 148 prostatectomies, 226 nephrectomies, and 428 kidney transplants were analyzed (Table 1).

Table 1. Number of cases and total operating room time for each procedure type.

	No. Cases	Median (min)	Longest OR Time (min)	Shortest OR Time (min)	IQR
Ureteroscopy	316	93.5	420	35	54.7
TURP	146	104	299	51	57.5
TURBT	182	82.0	261	28	51.0
Prostatectomy	150	326	880	167	223
Nephrectomy	226	300	833	58	131
Kidney Transplant	428	303	766	169	113

TURP = transurethral resection of the prostate; TURBT = transurethral resection of bladder tumor; No. Cases = number of cases; OR = operating room; IQR = interquartile range.

3.1. Ureteroscopy

For the 316 cases, the mean BMI was 32, the majority of cases had an ASA status of class II or III, and 116 patients had pre-admission testing performed. The mean total operating room time was 97 min. The underweight BMI category was found to be significant (*p*-value = 0.024), with a 48.7% decrease in total OR time compared with the healthy weight range (Table 2). PAT was not found to have a significant time difference (*p*-value = 0.222). The overweight, Class I, Class II, and Class III BMI categories were not found to have a significant time difference (*p*-values = 0.488, 0.846, 0.344, 0.059, respectively). ASA II, ASA III, and ASA IV were not found to have a significant time difference (*p*-value = 0.729, 0.617, 0.378, respectively).

Table 2. Linear regression analysis of patients who underwent ureteroscopy.

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	116	0.059	0.048	6.07	−3.67	16.6	0.222
BMI							
Healthy (ref.)							
Underweight	6	−0.397	0.175	−48.7	−110	−5.33	0.024
Overweight	78	−0.052	0.075	−5.33	−22.0	10.0	0.488
Class I	71	0.015	0.076	1.51	−14.3	17.8	0.846
Class II	59	−0.075	0.079	−7.79	−26.1	8.44	0.344
Class III	52	0.157	0.083	17.0	−0.60	37.7	0.059
ASA Status							
ASA I (ref.)							
ASA II	133	0.039	0.112	3.98	−19.8	29.4	0.729
ASA III	161	0.056	0.112	5.76	−17.8	31.9	0.617
ASA IV	11	0.148	0.167	16.0	−20.0	61.1	0.378

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

3.2. Transurethral Resection of the Prostate

For the 146 cases, the mean BMI was 29, the majority of cases had an ASA status of class III, and 76 patients had pre-admission testing performed. The mean total operating room time was 106 min. TURP did not exhibit a statistically significant time difference with any of the BMI or ASA categories (Table 3). The underweight class is not represented in the table, as no cases were classified as underweight.

Table 3. Linear regression analysis of patients who underwent a transurethral resection of the prostate (TURP).

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	76	−0.062	0.059	−6.39	−19.5	5.55	0.296
BMI							
Healthy (ref.)							
Overweight							
Class I	39	−0.110	0.086	−11.6	−32.2	6.18	0.204
Class II	14	−0.182	0.110	−20.0	−49.0	3.46	0.098
Class III	5	0.123	0.163	13.1	−22.1	56.2	0.453
ASA Status							
ASA I (ref.)							
ASA II	46	0.238	0.202	26.9	−17.6	89.1	0.241
ASA III	90	0.250	0.201	28.4	−15.8	91.2	0.215
ASA IV	7	−0.018	0.233	−1.82	−61.4	55.7	0.939

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

3.3. Transurethral Resection of Bladder Tumors

For the 182 cases, the mean BMI was 29, the majority of cases had an ASA status of Class III, and 82 patients had pre-admission testing performed. The mean total operating room time was 83 min. PAT significantly impacted the OR time (p-value = 0.009), with a 17.1% decrease in the total OR time compared to cases without PAT (Table 4). There were no ASA Class I cases. Therefore, the OR times for ASA Class III and IV are compared with ASA class II. The underweight, overweight, Class I, Class II, and Class III BMI categories were not found to have a significant time difference (p-values = 0.951, 0.517, 0.138, 0.320, 0.869, respectively). ASA III and ASA IV were not found to have a significant time difference (p-value = 0.632, 0.152, respectively).

3.4. Prostatectomy (Robotic-Assisted)

For the 148 cases, the mean BMI was 29, the majority of cases had an ASA status of Class II or Class III, and 106 patients had pre-admission testing performed. The mean total operating room time was 364 min. BMI Class I, Class II, and Class III were statistically significant, with p-values of 0.002, 0.019, and 0.016, respectively (Table 5). BMI Class I showed a 31.7% increase in the total OR time compared to the healthy weight range. BMI Class II showed a 24.6% increase in the total OR time compared to Class I. BMI Class III showed a 21.3% increase in the total OR time compared to Class I. PAT was not found to have a statistically significant time difference (p-value = 0.166). The underweight and overweight BMI categories were also not found to have a statistically significant time difference (p-value = 0.738, 0.568, respectively). None of the ASA classes were found to have a statistically significant time difference.

Table 4. Linear regression analysis of patients who underwent a transurethral resection of the bladder tumor (TURBT).

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	82	−0.158	0.059	−17.1	−31.6	−4.02	0.009
BMI							
Healthy (ref.)							
Underweight	6	−0.010	0.164	−1.01	−39.5	36.8	0.951
Overweight	64	−0.052	0.079	−5.33	−23.1	11.1	0.517
Class I	38	0.134	0.090	14.3	−4.39	36.5	0.138
Class II	22	0.106	0.106	11.1	−11.0	37.2	0.320
Class III	11	−0.023	0.137	−2.33	−34.2	28.3	0.869
ASA Status							
ASA II (ref.)							
ASA III	138	−0.038	0.080	−3.87	−21.7	12.6	0.632
ASA IV	13	0.191	0.133	21.0	−7.36	57.5	0.152

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

Table 5. Linear regression analysis of patients who underwent robotic-assisted prostatectomy.

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	106	−0.132	0.068	−16.4	−30.5	0.20	0.053
BMI							
Healthy (ref.)							
Underweight	1	−0.130	0.374	−2.74	−138	84.0	0.729
Overweight	64	0.048	0.084	6.18	−12.5	23.7	0.569
Class I	37	0.293	0.093	37.7	11.4	61.1	0.002
Class II	18	0.271	0.114	24.6	4.71	64.2	0.019
Class III	2	0.655	0.269	21.3	13.0	228	0.016
ASA Status							
ASA I (ref.)							
ASA II	59	0.145	0.147	19.8	−15.6	54.7	0.324
ASA III	81	0.278	0.146	42.3	−1.01	76.1	0.059
ASA IV	3	−0.372	0.295	11.6	−23.5	160	0.209

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

3.5. Nephrectomy

For the 226 cases, the mean BMI was 30, the majority of cases had an ASA status of Class II, and 137 patients had pre-admission testing performed. The mean total operating room time was 298 min. No associations were statistically significant (Table 6).

Table 6. Linear regression analysis of patients who underwent nephrectomy.

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	137	0.005	0.055	0.501	−11.0	12.1	0.924
BMI							
Healthy (ref.)							
Underweight	3	−0.161	0.226	−17.5	−83.3	32.8	0.476
Overweight	60	0.069	0.071	7.14	−7.47	23.2	0.336
Class I	62	0.117	0.073	12.4	−2.63	29.8	0.109
Class II	26	0.038	0.094	3.87	−15.7	25.0	0.683
Class III	17	0.082	0.109	8.55	−14.22	34.6	0.453
ASA Status							
ASA I (ref.)							
ASA II	69	−0.036	0.079	−3.67	−21.0	12.6	0.645
ASA III	101	0.064	0.077	6.61	−9.20	24.0	0.407
ASA IV	15	0.073	0.122	7.57	−18.1	36.8	0.547

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

To explore nephrectomy cases further and determine any statistical significance between open nephrectomies, robotic-assisted nephrectomies using da Vinci, and laparoscopic nephrectomy cases, nephrectomy cases were stratified as such and analyzed. There were 31 open nephrectomy cases, with 10 that underwent PAT. There were 115 robotic-assisted nephrectomy cases, with 80 that underwent PAT. There were 80 laparoscopic nephrectomy cases, with 71 that underwent PAT.

For all three techniques, none of the associations were found to have a statistically significant time difference (Tables 7–9).

Table 7. Linear regression analysis of patients who underwent open nephrectomy.

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	10	0.198	0.324	17.4	−60.2	138	0.546
BMI							
Healthy (ref.)							
Underweight	8	0.172	0.320	13.8	−63.1	130	0.595
Overweight	9	0.384	0.309	35.3	−29.0	178	0.226
Class I	1	0.852	0.721	29.7	−89.3	941	0.249
Class II	2	−0.142	0.573	−6.18	−276	183	0.806
Class III	18	0.058	0.354	5.02	−96.2	120	0.872
ASA Status							
ASA I (ref.)							
ASA II	8	−0.069	0.413	−5.34	−152	119	0.868
ASA III	10	0.198	0.324	17.4	−60.2	138	0.546
ASA IV	8	0.172	0.320	13.8	−63.1	130	0.595

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

Table 8. Linear regression analysis of patients who underwent Da Vinci-assisted nephrectomy.

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	80	0.001	0.092	0.20	−13.1	13.3	0.987
BMI							
Healthy (ref.)							
Overweight	35	−0.135	0.063	−23.4	−34.6	2.63	0.099
Class I	29	0.016	0.081	2.43	−16.8	20.7	0.849
Class II	17	−0.165	0.101	−21.8	−44.1	3.67	0.107
Class III	11	−0.051	0.117	−5.23	−32.7	19.8	0.664
ASA Status							
ASA I (ref.)							
ASA II	40	−0.022	0.082	−3.56	−20.3	15.0	0.788
ASA III	48	0.018	0.085	3.05	−16.3	20.6	0.831
ASA IV	5	0.061	0.152	4.29	−27.1	43.6	0.687

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

Table 9. Linear regression analysis of patients who underwent laparoscopic nephrectomy.

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	71	−0.125	0.083	−19.7	−33.8	4.19	0.138
BMI							
Healthy (ref.)							
Overweight	3	−0.027	0.210	−1.51	−56.0	47.8	0.897
Class I	28	0.170	0.109	22.8	−4.81	47.4	0.122
Class II	40	0.073	0.106	10.3	−14.9	33.0	0.495
Class III	12	0.082	0.142	7.47	−22.3	43.9	0.566
ASA Status							
ASA I (ref.)							
ASA II	6	0.028	0.201	1.82	−45.4	53.7	0.890
ASA III	35	−0.098	0.116	−14.1	−38.8	14.1	0.400
ASA IV	60	0.077	0.106	11.9	−14.5	33.5	0.473

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

3.6. Kidney Transplant

For the cases, the mean BMI was 29, the majority of cases had an ASA status of Class III, and 53 cases had PAT performed. There were no cases with an ASA Class I, so the OR times for ASA Classes III and IV were compared with Class II. PAT showed a significant 10.3% increase in the total OR time (p-value = 0.010). Class I obesity showed a significant 9.42% increase in the total OR time (p-value = 0.008) and Class II was found to have a significant 19.7% increase in the OR time (p-value = 0.010) compared to healthy weight (Table 10). The underweight, overweight, and Class III BMI categories were not found to have a statistically significant time difference (p-value = 0.423, 0.065, 0.651, respectively). ASA III and ASA IV were not found to have a statistically significant time difference (p-value = 0.182, 0.250, respectively).

Table 10. Linear regression analysis of patients who underwent a kidney transplant.

	No. Cases	Beta	Coefficient Std. Error	Time Difference (%)	Lower Bound (%)	Upper Bound (%)	*p*-Value
PAT							
No (ref.)							
Yes	53	0.098	0.038	10.3	2.43	18.9	0.010
BMI							
Healthy (ref.)							
Underweight	9	−0.076	0.094	−7.90	−29.8	11.6	0.423
Overweight	162	0.059	0.032	6.08	0.004	13.1	0.065
Class I	123	0.090	0.034	9.42	2.33	17.0	0.008
Class II	16	0.180	0.069	19.7	4.39	37.2	0.010
Class III	4	−0.059	0.131	−6.08	−37.2	22.0	0.651
ASA Status							
ASA II (ref.)							
ASA III	43	−0.173	0.129	−18.9	−53.1	8.44	0.182
ASA IV	10	−0.153	0.133	−16.5	−51.3	11.4	0.250

PAT = pre-admission testing; BMI = body mass index; ref. = reference; ASA = American Society of Anesthesiologists; No. Cases = number of cases; Time Difference (%) = percentage of time difference compared to reference group; Lower Bound (%) = 95% confidence lower bound; Upper Bound (%) = 95% confidence upper bound.

4. Discussion

Our analysis indicates that some patient factors had statistically significant effects on the total OR times of many urologic procedures. BMI was found to have a statistically significant time difference in ureteroscopy, prostatectomy, and kidney transplant procedures. ASA class was not found to have a statistically significant effect on the total OR time. PAT was found to have a statistically significant time difference in TURBT and kidney transplant procedures.

Obesity has been associated with hypertension and type 2 diabetes mellitus, as well as many other health risks [15]. Furthermore, deviations in BMI are also associated with surgical complications. Many earlier studies investigated BMI and its effects on the outcomes of urologic procedures. One such study found that complications following radical cystectomy occurred at an increasingly higher rate for patients with a higher BMI, with outcomes such as pulmonary, infectious, and bleeding complications [16]. While few studies investigated how BMI correlates with the total operating room time for urologic procedures, BMI was shown to affect operating time in many other surgical procedures. A retrospective study that observed 19,337 patients who underwent lobectomy found that for every 10-unit increase in BMI, there is a 7.2 min increase in the total operating room time [17]. However, another study found that BMI had no effect on operating room time for spinal fusions [18]. It is likely for results to differ when considering the type of procedure, the number of cases analyzed, and other factors such as surgeon experience and inclusion of various surgical procedures. Our study showed a statistically significant decrease in the total OR time for only the underweight category in ureteroscopy. As ureteroscopy is an endoscopic procedure, it is not surprising that the overall BMI would not have a significant effect on the total OR time. This also explains why BMI was not found to be significant in TURP and TURBT procedures. Although underweight was found to be statistically significant in ureteroscopy, it is also worth noting that there were relatively few underweight cases in our analysis. Our data also showed that BMI correlated with changes in the OR time for multiple categories in prostatectomy and kidney transplant procedures. Our data showed that a higher BMI correlates with an increased OR time for prostatectomy and kidney transplant procedures. Statistical significance was noted for Class I, Class II, and Class III obesity in prostatectomy, while BMI was statistically significant for both Class I and Class II obesity in kidney transplants. This supports our hypothesis that an increase in BMI would correlate with an increase in the OR time for open and robotic-assisted surgical procedures. Conclusions cannot be drawn about the effect of class III obesity in prostatectomy due to

only having two cases in that category, despite being statistically significant. Likewise, statistical significance was likely not achieved across all BMI categories for these procedures due to the lower number of cases for each insignificant category. Generally, we noted that BMI categories that were statistically significant also had the highest number of cases among all BMI categories for that procedure.

ASA status has also been shown to affect operating room time for many types of procedures. In a study that analyzed 685 hand surgeries, it was shown that a decrease in ASA status led to a significant decrease in the OR time [19]. ASA Class IV was also found to double the anesthesia preparation time in children and triple it in adults [20]. Our study did not find a statistically significant difference for ASA in any of the categories for any procedure type. Factors that can impact the prolonged OR time of these higher ASA class patients include longer set-up times, more invasive monitoring, and an increased number of interactions and treatments during surgery to mitigate negative health outcomes. It is possible that the anesthesia team had more experience dealing with complications arising from urologic procedures and was therefore not significantly affected by ASA class. Furthermore, it may be that ASA class does not have a significant effect due to the varying factors that determine ASA class. Comorbidities that lead to an increase in ASA class may not necessarily correlate with an increase in the total OR time in the context of the procedures we analyzed. However, our results suggest that ASA class is not correlated with a significant increase in total OR time.

The goal of pre-admission testing is to facilitate perioperative decisions and mitigate unforeseen risks by informing providers of pertinent predispositions. While there is a lack of studies that analyze the role of pre-admission testing on operating room time, studies have shown that visits to preoperative clinics can reduce cancellations and delays in the operation [14,21]. Our findings regarding TURBT may support the use of PAT as a tool to improve OR efficiency at hospitals, while being contrary to our hypothesis. However, PAT significantly increased the total OR time in kidney transplant cases. This may be due to the various comorbidities found in prospective kidney transplant patients, which may contribute to prolonged operative durations [22]. Other procedures we analyzed were not found to be significant for PAT. Therefore, it is uncertain how effective PAT is for generally increasing efficiency in the OR.

Overall, our findings support factoring in BMI when it comes to operating room scheduling and resource planning for open and robotic-assisted urologic procedures. For patients with a higher BMI, it may be beneficial to plan for a longer case which may warrant increased billing. However, for endoscopic urologic procedures, our study shows that BMI does not have a strong correlation with operating room time. Therefore, resource planning would not need to consider BMI. While our findings support a correlation between BMI, ASA class, or pre-admission testing and the total OR time, this study included a single medical center with limited sample sizes. Furthermore, we did not take into account the surgical complexity of each procedure. There were also multiple surgeons for each procedure type, and in this study, we did not consider the level of experience of the operating teams performing the procedure. To confirm these correlations, additional observational studies and large-scale randomized trials to compare these parameters and confirm the extent of their effects in improving efficiency in the OR more accurately are needed. Additionally, future studies should look to delineate the impacts that additional variables play on surgical time in urological procedures such as case complexity, surgeon experience, or case factors such as prostate volume in TURP and stone location and size in ureteroscopy. Future studies could also investigate the correlation of these patient factors on pure surgical time.

5. Conclusions

BMI, ASA status, and pre-admission vary in their effects on urologic procedures. A higher BMI significantly increases the total OR time for open and robotic-assisted surgical procedures but has a minimal effect on endoscopic procedures. ASA status was not found

to correlate with statistically significant differences in the total OR time for any procedures, which calls into question whether this can be used as an accurate predictor of the total OR time. Likewise, while PAT has also been shown to correlate with changes in the total OR time, it is unclear from our study whether the use of PAT correlates with an increase or decrease in OR time, and would require further studies to draw definitive conclusions.

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