



Risk-based stratification triaging system in pediatric urology: what COVID-19 pandemic has taught us

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Abstract

Introduction and objective SARS-COV-2 pandemic has affected the population worldwide requiring social distancing, quarantine and isolation as strategies to control virus propagation. Initial measures to reduce the burden to the health care system during the pandemic included deferring elective surgery. These damage control measures did not take into account the mid- and long-term implications. Management of congenital anomalies can be time sensitive with delays resulting in permanent disability, morbidity and increased costs to the healthcare system. This study reports the results of using a novel scoring system that enables triage of time sensitive congenital anomalies and pediatric surgical conditions and how implementation of Enhanced Recovery After Surgery (ERAS®) principles allowed optimization of resources and reduced the burden to the system while allowing for appropriate care of pediatric patients with urgent urologic surgical conditions.

Methods We present a prospective case series of patients with congenital urological conditions scheduled and taken to surgery during COVID-19 pandemic. All pediatric urology cases that were pending and or scheduled for surgery at the moment the pandemic struck as well as all cases that presented to the emergency department with urological conditions were triaged and included for analysis using a modified Medically Necessary, Time-Sensitive Procedures: Scoring System (MeNTS). A modified MeNTS was implemented for pediatric patients, giving more priority to the impact of deferring surgical intervention on patient's prognosis. An individualized evaluation using this scoring system was applied to each patient. Intra- and postoperative ERAS® principles were applied to all cases operated during the pandemic between March 20th and April 24th to reduce the burden to the healthcare system.

Results A total of 49 patients were triaged and included for analysis with a mean age of 6.47 years of age. Adjusted MeNTS showed that all clinically emergent cases had a score of 12 or less. Cases that could be postponed for 2 weeks but no longer had a score between 13 and 15. The ones that could wait 6 weeks or longer had scores higher than 16. Score results were not the same for similar procedures and individualized assessments resulted in scores based on an individual patient's conditions. From the total cases, implementation of ERAS® principles increased outpatient procedures from 68 to 90.4%.

Conclusion Our results provide a novel triaging method to rank pediatric urological surgical management based on individualized patient's clinical conditions. Cutoff values of 12 and 16 allowed appropriate triage preventing the postponement of urgent urologic cases during the COVID-19 pandemic. Implementation of ERAS® principles allowed for these procedures to be done in the outpatient setting, preserving valuable healthcare resources.

Type of study Prospective cohort study.

Level of evidence IV.

Keywords Enhanced recovery after surgery · Pediatrics · COVID-19 pandemic, SARS-COV-2 pandemic

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Introduction and objective

SARS-COV-2 pandemic has affected the population worldwide requiring social distancing, quarantine and isolation as strategies to limit spread of the virus. Health systems have been forced to redistribute resources toward emergency services and intensive care units. In an effort to preserve resources and protect patients and providers, most elective procedures have been postponed and while others have been performed using regional anesthesia in an effort to shorten hospital stays [1]. In adult surgery, clear guidance on how to decide which procedures should be prioritized were published during the pandemic [2–4]. However, in pediatric urology these protocols are not applicable worldwide [5]. Care of children with pediatric urologic anomalies varies widely based on availability of pediatric expertise in the local healthcare system. As a result, provision of care to these patients is often delayed, placing them at an increased risk for needing urgent care. These delays are only further exacerbated by the pandemic. It is unknown how much longer it will take once pandemic surge is contained and a plateau or recovery phase begins. As a result, the impact on morbidity and prognosis on our pediatric urological population is unknown [1, 6].

It is imperative to swiftly triage patient care in a safe and efficient manner without compromising quality. The purpose of this article is to demonstrate the impact of a modified triage scoring system for pediatric urology patients with urgent clinical conditions and the impact of ERAS® principles on the burden of care to the healthcare system during COVID-19 pandemic.

Patients and methods

Background and triaging system creation

After mandatory social isolation policies were published by local authorities, an immediate moratorium on elective surgery was instituted, creating an urgent need to triage patients. For that reason, we initially created a list of all pending cases and reviewed each case individually looking at patient's clinical status and indications for surgery. Implementation of a modified version of the Medically Necessary, Time-Sensitive Procedures: Scoring System (MeNTS) was created and applied for the present study. The reasons to modify the score were based on the fact that implementation of the originally proposed MeNTS scoring system did not allow us to individualize patient's clinical needs nor the urgency of each procedure. The lack of a clear cutoff value for the MeNTS did not allow us to

really triage our patients and also, MeNTS score was never designed for the pediatric population.

Each case was individually evaluated by the authors and other providers, all members of the COVID-19 surgical response team. Revision and triaging of our patients, was done following the same proposed protocol as described originally by Prachand et al.

The modification to scoring was based on increased weight (60% of the total score) applied to patient's condition and the impact on the long-term prognosis. This percentage was chosen in agreement by all the authors and other members of the department. The rationale was supported after careful estimation on how important the individual clinical scenario was. Standardized clinical simulation scenarios were made with same condition and same procedure but with different clinical prognosis and needs. Increasing percentages were used to calculate the total score and we found that to really discriminate for individual clinical needs, a 60% of the total score should be given to patient's individual condition and prognosis. The potential burden to the health system (30% of total score) was also accounted for in the modification as it was absent in the original scoring scheme [7]. The reason for this was also carefully analyzed by the team members following the same aforementioned rationale. The remaining 10% of the total score was estimated by patient's own risk factors (age, comorbidities and risk of COVID-19 infection at the time of surgery (Table 1). This last percentage was supported by available literature that reports low morbidity to pediatric patients infected with SARS-COV-2 [6].

After scoring system had been proposed and final score weight had been proposed, a validation phase was then carried out. Validation of the adjustments was performed using the available cases booked for surgery as well as our historical cases that had been operated since the beginning of the year (January 2020). Validation was independently performed by two blinded evaluators. A total of 180 cases were used for validation. The score was designed in a way that the lower the score the higher the priority the patient for surgical intervention with higher negative impact if surgery had to be postponed. For final triaging and ranking, the order and priority for surgery was defined by ascending scores with the lowest being the ones to be performed first. For those cases where discrepancies in the final score of more than 2 points were identified, evaluators reviewed and solved discrepancies.

Patient care and triaging system implementation

Between the 20th of March 2020 and the 24th of April 2020 and during mandatory lockdown, a total of 49 patients were triaged using the modified triage scoring system. Patients included were all those that presented to the emergency

Table 1 Risk stratification triaging system for pediatric surgical patients

Risk Stratification Triaging System for Pediatric Surgical Patients							
Patient's factors							
Variable	1	2	3	4	5		
10%	Age, Mo	153 to 216	89 to 152	25 to 88	2 to 24	<1	
	Preterm	None	-	-	-	Present	
	Low birth weight	None	-	-	-	Present	
	Cardiovascular malformation	None	Solved/Treated	Mild*	Moderate*	Severe*	
	Asthma/ Respiratory condition	None	-	-	Minimal (inhaler)	More than minimal	
	Inmunocompromised	No	-	-	Moderate	Severe	
	Ill symptoms	None	-	-	-	Present	
	Exposure to Known Covid-19 positive person in the past 14 days	No	Probably not	Possibly	Probably yes	Yes	
Impact of postponing surgical intervention							
Variable	1	2	3	4	5		
60%	Nonoperative treatment option effectiveness	None available	Available, <40% as effective as surgery	Available, 40% to 60% as effective as surgery	Available, 61% to 95% as effective as surgery	Available, equally effective	
	Nonoperative treatment option resource/ exposure risk	Significantly worse/not applicable	Somewhat worse	Equivalent	**Better	**Significantly better	
	Impact of 2-wk delay in disease outcome	Significantly worse	Worse	Moderately worse	Slightly worse	No worse	
	Impact of 2-wk delay in surgical difficulty/ risk	Significantly worse	Worse	Moderately worse	Slightly worse	No worse	
	Impact of 6-wk delay in disease outcome	Significantly worse	Worse	Moderately worse	Slightly worse	No worse	
	Impact of 6-wk delay in surgical difficulty/ risk	Significantly worse	Worse	Moderately worse	Slightly worse	No worse	
Procedure Associated Factors							
Variable	1	2	3	4	5		
30%	OR time in minutes	< 30	30-60	61-120	121-180	>180	
	Estimated Length of stay	Outpatient	<24 hours	24-48 hours	2-3 days	>3 days	
	Postoperative ICU need likelihood	Very unlikely	< 5%	5 -10%	11 – 25%	> 25%	
	Surgical team size	1	2	3	4	5 or more	
	Type of surgical access	None of the others	Minimally invasive abdominal/pelvic	Open infraumbilical abdominal/pelvic	Open supraumbilical abdominal/pelvic	ORL or Upper GI tract or Thorax	
	Requirement of a second procedure	No	-	-	-	Yes	

department with a surgical urological condition and those that had been booked prior to the beginning of the pandemic and were waiting to be operated. All cases were reviewed individually. We collected demographic and clinical data. Once all cases had been assessed by the adjusted triaging system, we prioritized the patients in ascending order based on the final score. Every 2 weeks, cases were re-triaged as clinical conditions could have changed impacting their prioritization score.

To reduce the burden to the system, we implemented ERAS[®] protocols. These were protocols that were not being used prior to the pandemic. Since our scoring system had been modified and 10% of the total score depended on how much burden would be put on the facilities and health system if surgery were to be performed, we looked into novel and different ways to reduce this. We found that final scores on the simulation scenarios and validation phase were consistently lower for all of the ambulatory procedures. For that reason, we decided to implement ERAS principles to our

cases and explore the potential change from inpatient to ambulatory procedures [8–10]. Perioperative pain control was of critical importance to achieve this objective by applying regional anesthesia/nerve blocks to minimize opioid utilization and improve recovery times. Prior to the pandemic, procedures such as ureteral reimplants, pyeloplasties and retrograde intrarenal surgery (RIRS) were admitted to the inpatient unit. Application of ERAS[®] principles allowed transition of inpatient procedures to the outpatient setting. Another change to our practice included that for all of these cases a postoperative follow-up was monitored by phone or telemedicine at 24 and 48 h. Parents/caregivers were provided with specific instructions after surgery on how to monitor urine output, how to care for drains or catheters and on how to manage pain with oral pain medications. No opioids were used for any of the ambulatory patients. For those who required double-J stent placement, we removed them after 72 h by pulling the strings without the need for an additional surgical intervention. We had no Salle stents available and all pyeloplasties were performed leaving a regular double-J stent in place.

Results

A total 49 patients, 40 boys and 9 girls with a mean age 6.47 years (13 days old–17 years of age) were included in this series. Distribution of cases and their average score is presented in Table 2. Based on our modified version of MeNTS, we found that all cases with a score of 12 points or less were treated emergently and this correlated completely with our clinical assessment. Twenty-three cases that required immediate surgical management due to their clinical condition had scores of less than 12. A total of 4 cases had scores between 13 and 15 and a total of 22 patients had a score above 16. Average score obtained for acute scrotum/testicular torsion was 9.3. Median score for cases with active infection of the urinary tract requiring surgical management was 10.6. Kidney and ureteral stone-related procedures had a mean score of 10.0. All other cases that required clinical urgent management had scores below 12. Cases with hypospadias had a median score of 19.5 and circumcisions without acute urinary retention had a median score of 19. Score results were not the same for each procedure and did reflect the individualized patient's current clinical condition and priority. For example, on Table 2, the circumcision with the lowest score, was a boy with severe chronic balanitis that was in urinary retention. All other circumcisions were non-emergent and no impact on their clinical prognosis would have been seen if postponed after 6 weeks.

Table 2 Distribution of cases based on modified scoring

Distribution of cases based on modified scoring		
Case	Procedure	Total score
1	Testicular detorsion and Orchiopexy	7.8
2	Double J catheter removal	7.9
3	Laparoscopic bilateral orchidopexy	8
4	Double J catheter removal	8
5	Ureterocele puncture	8.1
6	Double J catheter removal	8.1
7	Circumcision	9.3
8	Robot assisted Pyeloplasty	9.5
9	Pyeloplasty	10
10	Retrograde intrarenal nephrolithotripsy	10
11	Laparoscopic bilateral orchidopexy	10.1
12	Retrograde intrarenal nephrolithotripsy	10.3
13	Circumcision	10.5
14	Ureteral reimplant	10.6
15	Ureteral reimplant	10.7
16	Ureterocystostomy	10.7
17	Laparoscopic Sober Ureterostomy	10.7
18	Ureterocystostomy	10.8
19	Testicular detorsion and Orchiopexy	10.9
20	Vesicostomy	11
21	Open Radical Nephrectomy	11.2
22	Open Pyeloplasty	12.3
23	Retrograde intrarenal nephrolithotripsy	12.4
24	Double J catheter removal	13.3
25	Double J catheter removal	13.3
26	Double J catheter removal	13.4
27	Inguinal Orchidopexy	13.4
28	Circumcision	17.6
29	Penile angle correction	17.7
30	Hydrocelectomy	18
31	Pyeloplasty	18
32	Circumcision	18.1
33	Urethrocuteaneous fistula repair	18.4
34	Hypospadias	18.5
35	Hypospadias	18.5
36	Hypospadias	18.6
37	Cystoscopy	18.6
38	Orchidopexy	18.7
39	Laparoscopic partial cystectomy	18.8
40	Hydrocelectomy	18.8
41	Circumcision	19
42	Hypospadias	19.7
43	Circumcision	19.8
44	Inguinal Orchidopexy	19.8
45	Circumcision	19.9
46	Hypospadias	20.1
47	Phalloplasty	20.9
48	Prophylactic Orchiopexy	21.4
49	Hypospadias	21.8

Discussion

COVID-19 pandemic has created a need to re-invent the way we practice medicine. Given the burden on healthcare systems and the risk to patient and staff, elective surgery was suspended immediately stop elective surgery. The impact of this decision created unanticipated impacts on waiting times that were already excessive, especially in low- to mid-income countries. As a guide, different American and European surgical associations including the American College of Surgeons, published guidelines to select and triage surgical interventions [7]. None of these guidelines was specific to pediatric urologic conditions and focused their design on the triage of cases based on procedure and not individualized patient's clinical conditions [11]. Recommendations for urologic conditions were created for the adult population making them less applicable to the pediatric patient.

Low- or mid-income countries have specific and unique limitations that make implementation of guidelines from a higher resourced very difficult. Reduced access to subspecialized trained personnel in the appropriate setting creates longer waiting times, more complicated surgical repair for the patient living in low-income countries [12]. Most recently, a publication from Quaedackers et al. made recommendations during COVID-19 pandemic, specifically on pediatric urological conditions and how to prioritize them based on procedure type and the urgency of the procedure without accounting for other factors such as the unique clinical situation of the patient and comorbidities and the possible burden to the health system if a procedure was to be performed [13].

We present a novel scoring system that individualizes the triage of patients based on the impact of postponing surgery and considers their unique clinical condition assisting the surgeon prioritize their cases for patient with pediatric urologic conditions. The reported complication rates from COVID-19 infection are low in children [6, 14, 15]. Thus, there is benefit in performing pediatric urological surgery during this pandemic to avoid further delays in care and associated complications. The argument to modify the original MeNTS scoring system was the impact of age which impacted the triage score in the adult population given their risk of morbidity and mortality associated with COVID. While age may impact the decision to defer a procedure in the adult population, its contribution to the pediatric risk profile is less important. Prachand's triage score was not originally designed for pediatric conditions and our modifications to this scoring system gave more weight to the impact of postponing surgical intervention of congenital anomalies on subsequent long-term outcomes [7].

Our scoring system allowed triage of patients based on individual clinical condition as oppose to triage based on

procedure only. We also took into consideration the potential impact and burden on the health care system as part of the scoring system and was factored into prioritizing the procedure. After reviewing the triage scores of our cohort, patients with scores below 12 required emergent treatment such as septic patients with need for surgical intervention, testicular torsion or obstructing kidney stones. Patients with triage scores between 13 and 15 could be deferred up to 6 weeks without a negative impact on their prognosis but could not be deferred longer. Based on our results, a good example is the case of an indwelling double-J stent that if left longer it can cause complications. Potential changes that could be considered to reduce the score even further for these specific situations would be to use strings to pull them without the need for another intervention or use Salle stents when possible. Patients with scores of 16 or greater could safely wait to be operated after 6 weeks without having a negative impact on their prognosis. A good example is a patient with hypospadias where deferring his care will not make the surgical procedure more difficult and the prognosis will not change overall if treatment is performed later. As a result, the triage scores of 12 and 16 were used as the cutoff values to define high (≤ 12), medium (13–15) or low (16 and greater) priority to triage cases. The patient's clinical condition impacted the triage score independent from the type of surgical intervention. For example, in our cohort, the case for bilateral laparoscopic orchiopexy (case number 3 on Table 2) had pre-operative imaging suggesting the presence of intraparenchymal gonadal neoplasia. For this reason, the score was significantly lower when compared to other cases of undescended testicle cases. In another example, a patient with acute urinary retention was prioritized for an emergent circumcision, typically a low priority procedure. In addition, patients' double-J stents in place with prolonged indwelling times and potential for significant calcification tended to have lower scores.

Conditions typically not urgent become so when care is delayed which is common in low-resource settings due to poor access to healthcare access. Furthermore, it is unknown how the COVID-19 pandemic will further delay care in these low-resource settings and affect with the long-term outcomes of children congenital anomalies. Surgery is instrumental in a reducing the cost and burden to the health care system associated with illness arising from delayed treatment of congenital anomalies on the health care system [16, 17]. The impact on the health outcomes of an already undertreated population compounded by the COVID pandemic are likely significant. For this reason, performing a triage system that accounts for patients' clinical condition, the type of surgery and the impact on the health care system allows for safe and efficient surgical management of patients with congenital anomalies in an effort to reduce the burden to the health care system long term.

A significant amount of urological congenital anomalies are time sensitive and care should not be delayed. Given the current pandemic, relocation of resources implies changes in how priority is distributed amongst the entire population. This is even more true in low- or mid-income countries. Prior to the pandemic, there was a group of procedures that were performed as inpatients such as ureteral reimplants, pyeloplasties, and retrograde intrarenal lithotripsies. Since one of our goals with this project was to be able to prioritize cases individualizing their clinical status without generating a higher burden to our hospital during the pandemic. Implementation of ERAS[®] principles helped in reducing this burden by increasing our outpatients from 68 to 90.4%. Our results also show how changes in managing protocols allow to reduce the burden without affecting patient's safety. An example is pyeloplasties. Before the pandemic, all cases were managed as inpatients for at least 24 h. Considering the need to avoid exposure of patients and their families to SARS-COV-2 while being at the hospital and also by trying to reduce the demand of hospital resources, we made a decision to perform these interventions whenever clinically possible as outpatient procedures. Available literature has become widely accepted and important to reduce hospital stay, postoperative complications and costs to the healthcare system [18]. We decided to focus on intraoperative elements that could be implemented, in an attempt to perform all cases as outpatient procedures. Regional anesthesia (quadratus lumborum, transverse abdominus and pudendal blocks) allowed our patients to be ready for discharge without any need for opioids. In addition, the possibility of minimally invasive procedures, judicious prevention of hypothermia and management of fluids as well as avoidance of drains or catheters made it a feasible approach [18, 19]. Although these measures were successfully implemented, most of current available data about ERAS[®] implementation on pediatric urology is insufficient [19–25]. Although a lot of debate around whether or not, laparoscopic surgery may increase the risk of COVID-19 transmission to the surgical team, there are no definitive data on how to proceed. We performed all cases with droplet precautions using full face masks with EPA P100 or N95 respirators. Massive implementation of COVID-19 testing prior to surgery might be a possibility, resources for such measures in low-resource setting care systems are not sustainable. All changes to medical care that have taken place to reduce the impact and control the pandemic have shown us how important it is to have a flexible and open-minded approach to innovate and adapt. Our results reflect the need to adapt and these adaptations can result in changes in surgical practice that will continue to improve value in healthcare.

This study demonstrates the feasibility of implementing fast track surgery care model with a reproducible triage scoring system for patients with congenital urologic anomalies.

While the triage system was used only congenital urological anomalies, we believe that this scoring triage system can be applied more broadly to other congenital anomalies. Ultimately, more studies and larger series are needed to better refine such scoring systems. Our experience and the experience of others have demonstrated that of scoring systems can drive decision making during situations in which access to healthcare resources is limited.

Conclusion

Our results present modified triage tool for patients with congenital urologic anomalies. Cutoff values of 12 and 16 allow to prioritize allocation of resources without deferring surgical repairs of congenital anomalies that otherwise would be affected if surgery had to be postponed based on recommendations during the COVID-19 pandemic. Implementation of ERAS[®] principles allowed for these procedures to be done in the outpatient setting, preserving valuable healthcare resources.

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Compliance with ethical standards

Conflict of interest None of the authors has any conflicts to declare. The author Nicolas Fernandez has no conflict of interest. The author Stefania Prada has no conflict of interest. The author Jeffrey Avansino has no conflict of interest. The author Julian Chavarriaga has no conflict of interest. The author Eduardo Hermida has no conflict of interest. The author Jaime Perez has no conflict of interest.

Ethical approval No animals were involved in the present study. All the procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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