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**Original Research Article**

# Impact of corona pandemic on paediatric surgical services: an institutional experience

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## ABSTRACT

**Background:** Corona-virus disease pandemic affected the health-care delivery at all institutions worldwide. Analysis of institutional data regarding management of surgical paediatric patients would reflect the impact and challenges which this pandemic brought by affecting the only functioning Paediatric surgery center in a poor province of a developing country. Objective was assessment of the impact of the COVID pandemic on the paediatric surgical services of a tertiary care center.
**Methods:** Retrospective data of all patients operated at the only functioning tertiary center in Bihar with pediatric surgical services during the COVID-related lockdown period were collected and compared to the immediate pre-lockdown period and after the lockdown period. The impact of following the guidelines for surgery during this period was studied.
**Results:** Both the number (0.8 cases/day) and types of patients operated in the lockdown period varied from the pre-lockdown period (3.62 cases/day). Elective cases were most significantly affected; neonatal, traumatic and malignancy cases could not be deferred and were therefore managed during the lockdown. Although the number of surgeries increased in unlock-down period (2.07 cases/day) and reached to a peak of 2.99 cases/day in the normal period between two phases of the pandemic; this increase was short-lived as the second phase of the pandemic again severely impacted the surgical care (1.38 cases/day).
**Conclusions:** Corona pandemic severely impacted both the number and types of patients operated. Strict adherence to the protocol delayed emergency treatment and increased the cost of definitive management.

**Keywords:** Corona virus, Lockdown, Pandemic, Paediatric surgery

## INTRODUCTION

Health care needs and its institution has not been the same since the World Health Organization (WHO) declared the ongoing outbreak of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) as a pandemic.[1] Unique challenges for the conduct of surgical procedure and anesthesia were faced in hospitals worldwide. Considering the sudden increase in the demands of viral diagnostic tests, personal protective equipment (PPE), N95 masks, isolated beds, ventilators, and intensive care units, even the most developed countries in the world appeared vulnerable.

In a resource challenged country like India with a huge population, management of hospitals is almost impossible if proper triage is not done between elective and emergency cases. This theme was the central guiding idea behind standard operating protocol (SOP) at the international, national and regional hospital levels. These

protocols brought about limitations in the services and functioning of even the most efficient of our hospitals.

Children have been found to be less affected by the virus; however, they are not immune to it.[2-4] Pediatric surgery department caters to a diverse set of patients ranging from different congenital neonatal anomalies to pediatric emergencies such as trauma and foreign body bronchus. Each of these indications has their own challenges and therefore such cases cannot be deferred. We present the surgical data and analyze the impact of this pandemic on the management of pediatric surgical cases at the only functioning tertiary care government hospital with pediatric surgical services in Bihar, a poor state in India.

## METHODS

A retrospective observational study was conducted in the department of pediatric surgery at Indira Gandhi Institute of Medical Sciences, Patna (a tertiary care center in Bihar) after approval from ethics committee (approval no. 1443/IEC/2020/IGIMS). 5 sets of retrospective data of all pediatric patients who underwent surgery for different indications during the COVID-19 pandemic were collected: 1st phase of lockdown (from 23 March 2020 to 31 May 2020); from January 2020 to the start of lockdown period; in the un-lockdown period (from 01 June to 30 November); from 01 December to 15 March; and from 16 March to 18 May 2021 (2nd phase lockdown) were collected after obtaining consent. This data included the demographic details, detailed history, diagnosis; investigation results, COVID-19 status, surgical details, waiting time before definitive management postoperative stay, any complications, and cost of management.

Data thus collected was analyzed using descriptive statistics. An online website for statistical computation 'Vassar stats' was used for statistical calculation. Mean data was obtained for total number of patients treated per day during different phases for comparison.

### *Standard protocol for managing surgical patients at this institution*

Being a global pandemic with initially no definite drug or vaccine against it, COVID-19 brought an unprecedented crisis because of its contagious nature. Social distancing to limit contact was the only means to check its spread which necessitated the enforcement of lockdown in various countries. In India, it was implemented on 23 March 2020 in different phases without a break between these phases. This continued till 31 May; after which un-lockdown was implemented in different phases gradually till 30 November. Finally, from December all restrictions on movement and contacts were removed and hospitals could now function with more autonomy. This normalcy was short-lived and after 15 March a rapid surge in the number of new cases with proportionate increase in mortality marked the arrival of 2nd phase and made total lockdown a necessity. This changed the status of this hospital into a COVID-dedicated hospital again with limitation and near stoppage of all surgical works.

During the lockdown period, as a protocol outpatients' clinic functioned under limitation to cater to the needs of only serious and emergency cases; all the elective cases were postponed and only emergency cases were operated. In Bihar, different hospitals were designated for COVID-positive and COVID-negative patients; a strict rule of treating COVID-positive patients in COVID hospitals and non-COVID patients in non-COVID hospitals was followed once reverse transcriptase-polymerase chain reaction (RT-PCR) results became obvious. In doing so, individual hospitals developed their own SOP which involved triaging of patients for their symptoms, admitting all emergency patients in isolated area, subjecting all admitted patients to RT-PCR for COVID-19, transferring patients who turn negative for these tests to the primary ward designated for the individual department whose care is essential for the definitive management of the patient and referring the COVID-positive patients to designated COVID hospitals for further treatment. The SOP also had provision for facilities of complete protection of all the health-care professionals by the provision of PPE including masks (level 2 or 3 filtering face piece depending on the aerosol-generating risk level), eye protecting goggles, double non-sterile gloves, gowns, suites, caps, and shoe-covers. Each department was allotted a specified time daily for telemedicine facility to advise non-emergent cases and follow-up cases. This further reduced the number of patients in the outpatients' clinic.

Any health-care professional or supporting staff, on accidental exposure to some COVID positive patient was quarantined for a period of 2 weeks as a part of the institutional SOP and on turning positive for corona virus, received treatment at an isolation center in designated COVID positive hospital.

## RESULTS

Table 1 shows the total no. of cases (both emergency and elective) done in these different periods. The number of elective cases during the lockdown period went down sharply compared to the other periods. However, the emergency cases continued despite restrictions imposed on the movement of patients and on admission in hospitals. The number of cases operated per day was the least during the lockdown period (0.8) as against 3.62 in the pre-lockdown period. This figure gradually improved in unlock down period and thereafter. The number of females operated during lockdown period was significantly less compared to males. No COVID-related complications were seen in the operated patients in any of the periods.

A wide range of age of patients treated during lockdown was seen (from 1 day to 17 years) with a mean of 21.53 months. Majority of the patients treated during this period were neonates, mostly due to a variety of malformations.

Table 2 summarizes the different indications for which surgery was done during the lockdown period and compares it to the number of surgeries done in the corresponding category just before lockdown. Almost all categories showed a decrease during the lockdown period. Congenital deformities in neonates were the most common indication for surgery during this period; most common among these were anorectal malformation, bowel atresia, oesophageal atresia, infantile hypertrophic pyloric stenosis; trauma cases had lessened at all institutions; only one case of polytrauma with pelvic and femoral fracture with urethral injury came to the hospital during lockdown; tumors were operated on a semi-emergency basis. Non-performance of elective cases such as pelvi-ureteric junction obstruction, hypospadias, epispadias–exstrophy bladder, asymptomatic renal and gallbladder stones, all types of stoma closure (bowel stoma, vesicostomy, ureterostomy), and asymptomatic cystic lesions (thyroglossal, mesenteric, choledochal, branchial) were the major cases which were deferred. Delaying stoma closure increased morbidity and cost of management. Other conditions did not cause any specific problem for the patient in our study. One case of acute appendicitis underwent laparoscopic appendicectomy while one patient with foreign body bronchus had bronchoscopic removal of the foreign body.

Number of patients who left against medical advice (LAMA) during the lockdown period increased (five in total); these patients were awaiting results of PCR for COVID-19. The attendants of all these patients feared of getting infected with the corona virus during their hospital stay.

**Table 1: Comparison of surgeries during the different periods.**

| Periods | No. of days | No. of emergency cases | No. of elective cases | Total cases | No. of cases per day | M: F | Any COVID related complication |
|---|---|---|---|---|---|---|---|
| **1: Pre-lockdown (01 January 2020–22 March 2020)** | 82 | 87 | 210 | 297 | 3.62 | 240: 57 | No |
| **2: Lockdown (23 March 2020–31 May 2020)** | 70 | 42 | 14 | 56 | 0.8 | 51: 5 | No |
| **3: Un lockdown (01 June 2020–30 November 2020)** | 183 | 92 | 287 | 379 | 2.07 | 293: 86 | No |
| **4: 01 December 2020–15 March 2021** | 105 | 96 | 218 | 314 | 2.99 | 250: 64 | No |
| **5: 16 March 2021–18 May 2021** | 63 | 22 | 65 | 87 | 1.38 | 69: 18 | No |

**Table 2: Common indications of surgeries performed during lockdown.**

| Indication | No. of cases in lockdown | No. of cases in pre-lock down | Effect of lockdown |
|---|---|---|---|
| **Neonatal cases** | 34 ($ARM_9$+$EA_4$+malrotation$_3$+$HD_4$+ $JIA_4$+$DA_2$+$NEC_2$+$CDH_2$+$PUV_1$+$IHPS_3$) | 49 | ↓↓ |
| **Trauma cases** | 1 | 4 | ↓↓ |
| **Tumours** | 3 | 5 | ↓ |
| **Foreign body bronchus** | 1 | 3 | ↓ |
| **Acute abdomen in older children** | 6 ($PP_2$+$IO_2$+$OH_1$+appendicitis$_1$) | 11 | ↓↓ |
| **Gastric outlet obstruction (secondary to acid ingestion)** | 1 | 3 | – |
| **Infected cases** | 4 (Abscess$_2$+infected $UPJO_1$+emyema decortication$_1$) | 3 | ↓ |
| **Biliary atresia** | 0 | 2 | ↓ |
| **Others** | 6 ($PPC_1$+urethralstricture$_1$+mesenteric cyst$_1$ + $CLE_1$ +stoma reversal$_2$) | 7 | ↓ |
| **Total emergency cases** | 42 | 87 | ↓↓ |
| **Elective cases** | 14 | 210 | ↓↓↓↓↓ |
| **Total** | 56 | 297 | ↓↓↓ |

ARM: Anorectal malformation; EA: esophageal atresia; HD: Hirschsprung's disease; JIA: jejunoileal atresia; DA: duodenal atresia; NEC: necrotising enterocolitis; CDH: congenital diaphragmatic hernia; PUV: posterior urethral valve; IHPS: infantile hypertrophic pyloric stenosis; PPC: pseudopancreatic cyst; CLE: congenital lobar emphysema; PP: perforation peritonitis; IO: intestinal obstruction; OH: obstructed hernia

In all, there were two deaths in the patients operated during lockdown but none of them were due to corona virus. Both patients had jejuno-ileal atresia (one had anastomotic leak and the other had accidental aspiration while feeding).

Four patients tested positive during lock down period and this institution being a declared "non-COVID" hospital, these patients were sent to a COVID-hospital for proper advice. Among them, a 2-year-old intussusception patient died later due to her sick state; while a child having pelvi-ureteric junction obstruction was operated when he turned negative for COVID-19. Two other positive patients (empyema thoracis and right-sided Wilms' tumor) were operated at another hospital designated to operate and take care of COVID positive patients.

Four nursing staff and one treating physician were found to be corona-positive. They were kept in quarantine and returned to work after testing negative after a couple of weeks.

**Table 3: COVID-19 specific measures at our hospital.**

| Measures | Whether taken or not? |
|---|---|
| **Online registration** | Yes |
| **Limiting number of patients in OPD** | Yes |
| **Triaging** | Yes |
| **Whether elective cases performed** | No |
| **Limiting admissions** | Yes |
| **Emergency cases** | Yes |
| **Initial admission in isolation** | Yes |
| **PCR-test after admission and before any other intervention** | Yes |
| **Availability of PPE kits/N-95 masks/face shields/protective goggles** | Yes |
| **Telemedicine OPD** | Yes |
| **Separate facilities for COVID–positive and COVID–negative cases** | Yes |
| **Division of healthcare workers in groups to work by turn** | No |
| **Measures during laparoscopic surgery** | Yes |
| Lower insufflation pressure | + |
| Desufflation by trocar suction | + |
| Use of filters | - |
| Specimen retrieval after desufflation | + |
| Use of smoke evacuators | - |
| Limited use of energy devices | + |

Following the protocol of testing for COVID-19 before surgery delayed surgery by an average of 20 hours; use of RT-PCR, protective kits and all other protective measures added additional cost of around Rs. 11, 500 (Indian rupees) in every patient. For several months after the lockdown period, following these strict protocols resulted in unnecessary waiting and chaos and added to the anxiety of the treating medical personnel as well as the patients and their relatives. Even after the lockdown was over, several patients deteriorated in the waiting area and many of them either died without surgery or worsened awaiting for surgery.

Table 3 summarizes the COVID-specific measures taken by our institution to manage patients during lockdown. All these measures had one basic theme – to limit the number of patients at registration, outpatient's department and indoor admission without denying care to the needy who presents with any emergent symptom.

In the second phase of the pandemic, after 14 April 2021 this centre became a COVID-dedicated hospital and all paediatric surgery (elective and emergency both) were stopped.

## DISCUSSION

The COVID pandemic has necessitated a change in the health-care delivery making "triage," an important step in prioritizing the management of patients. This has affected the surgical disciplines the most.[5] The European association of urology guidelines office suggested key points for prioritization of surgical care.[6] This includes the impact of delay on the outcome of surgical procedure, feasibility of alternative procedures, the risks to the patient's life or organ dysfunction if surgery is delayed, presence of co-morbidities and increased risks of complications and the risks of progression of symptoms or disease progression if the procedure is not performed.[6] Therefore, a balance between the patient's needs, available resources and the risks of deferring surgery must be taken into consideration when decision regarding an individual patient is to be taken.

Different countries and institutions have had their own recommendations regarding elective and emergency surgeries. The approach varies even between two departments in the same institution, while also obeying the institutional protocol. The American college of surgeons have divided the operative procedures into different tiers depending upon the urgency of surgery; they recommend postponement of all surgeries up to tier 2b.[7] This, however, does not apply to majority of high risk cancer surgeries and surgical patients who are very sick to survive without an operative procedure (tiers 3a and 3b).[7]

As per the guidelines of the Indian Council of Medical Research (ICMR), all high-risk cases who need surgery should undergo PCR test for COVID-19 before surgery (all symptomatic contacts of laboratory-confirmed cases or asymptomatic-direct and high-risk contacts of a confirmed case should be tested once between day 5 and day 14 of coming in his/her contact).[8] Thereafter, if the patient's PCR test is negative, he undergoes surgery with precautions as per surgical protocol; if positive, he is kept in isolation meant for COVID-19 positive patients and operated with tertiary protection measures for anesthesia

and surgery. In the postoperative period, patient is again managed in isolation ward. The protocol followed in our department was in line with the protocol given by the American college of surgeons, ICMR and the institutional SOP.

Our hospital was designated as a non-COVID hospital by the state government of Bihar and has been assigned to treat non-COVID emergency cases. By doing so, a vast majority of surgical patients who need emergency treatment and were negative for COVID-19 could be managed without giving them and the entire health care providing team an undue risk of getting infected. Therefore, SOP of the institute was to admit all emergency cases in isolation ward and to shift to respective place of treatment after their COVID report. COVID positive cases were to be transferred to designated COVID hospital; only, COVID negative patient were treated taking all universal safety precautions by using personal protection kit. Because of the lockdown across the country and state, the numbers of patients were limited even in emergency. Emergency admissions in paediatric surgery department were almost comparable with last year's admissions; whereas other departments were getting fewer numbers of emergency cases. This could be because of the fact that ours is the only regional institute rendering emergency services in paediatric surgery. Less vehicular movement and option of emergency services at other centers were the main cause of poor attendance in emergency services of other departments.

Surgical procedure being teamwork, the conduct of a single surgery exposes the entire health-care team involved in hospital registration, outpatient consultation, admission, inpatient care, investigation and radiological workup, anesthetic procedure, definitive surgery, postoperative care and sanitation and disinfection measures to the risks of this virus. Hence, strict measures must be taken at every level to lessen the exposure; online registration, restricting the counts of patients turning up for outdoor consultation to only those having emergent symptoms, initial isolation followed by PCR test for corona virus followed by all other investigations and resorting to primary, secondary and tertiary protection measures as per the risk group of the patient.[4]

Our hospital limited its outpatients' clinic as a part of its COVID containment strategy. Only emergency and life-threatening cases were operated. For other patients, telemedicine sessions were used. Use of telemedicine or tele-health services saw a surge during the pandemic.[9,10] Such facilities ensure delivering health-related advice to those in need without unnecessary crowding in the hospital premises. However, only medical advice can be given through this medium; patients can only be advised to come to the treating center, should any need for surgical intervention arise. Also, public awareness is lacking regarding such facilities which is reflected by the limited number of patients availing them.

Different subgroups of surgical patients who received surgical care are evident on analyzing our data.

Trauma patients constitute a subgroup that needs treatment despite their COVID-status.[11] Fortunately, with the imposed lockdown and restriction to unnecessary movement and transportation, the overall number of these patients declined considerably. In our study, trauma patients were very few in number and they were managed following appropriate guidelines.[12,13]

Neonatal surgical deformities formed the bulk of the operated patients. Anorectal malformation, esophageal atresia, jejuno-ileal atresia, duodenal atresia, malrotation with midgut volvulus, necrotizing enterocolitis, Hirschsprung's disease, idiopathic hypertrophic pyloric stenosis, congenital diaphragmatic hernia, congenital lung cysts, biliary atresia and posterior urethral valves were some common conditions for which surgery was performed. This spectrum mimics the range of cases found during non-COVID times. So, with regard to neonatal surgery no limitation was observed for any specific condition. None of these conditions can be considered non-life-threatening or not capable of causing any organ damage. Children with bowel atresia had a prolonged hospital stay, often exceeding 2 weeks, thereby making them at risk for exposure.

Cancer surgeries, on most occasions, cannot be deferred fearing tumor growth, its spread (metastases) and risk to life. These points must be carefully balanced against the risks of viral transmission to these patients (due to their immuno-compromised state).[14] All tumor surgeries were done on semi-emergency basis and their hospital stay was kept as short as possible by allowing early feeds and mobility, lessening their overall exposure. Wherever applicable, they were also sent for chemotherapy and radiotherapy after discussion in online Institutional tumor board to provide comprehensive cancer care.

The number of emergencies in grown up children were fewer and their number had declined compared to the non-COVID period. Some of these included foreign body bronchus, acute appendicitis, empyema thoracis, intestinal obstruction, perforation peritonitis and tumors. We followed the guidelines whereby a diversion stoma is preferred over an anastomosis if a choice has to be made between the two. This lessens the chances of a second surgery, should an anastomotic leak occur. SARS-CoV-2 has been found in many fecal specimens and this implies precaution during bowel surgeries.[15-17]

The advantages and disadvantages of laparoscopic surgery during COVID period have often been compared.[18,19] Less trauma, faster recovery and discharge, contained surgical field limiting exposure to fumes and fluids, wider spacing between persons involved in surgery and anesthesia are some direct advantages of laparoscopic procedure; however, energy devices, surgical plume and smoke have been regarded as potential risk factors for viral

transmission. These risks are not well substantiated by available data. Using filters and safe smoke evacuator for the released carbon dioxide during surgery, creating a closed circuit for insufflation preventing any release of free gas during the procedure, limiting the use of energy devices to minimum and lessening the insufflation pressure to decrease the risks of aerosolization of the virus are a few described measures. In case, smoke evacuators are not available, direct application of suction device to the laparoscopic trocars facilitates safe disposal of the smoke. We had only two laparoscopic procedures during this period and both these patients were discharged the next day. We used lower insufflations pressures, applied suction to the trocar to achieve safe evacuation of gas and smoke and retrieved the surgical specimen after desufflation.

A disturbing trend was increase in the number of patients going LAMA or deteriorating in the isolation area waiting for the COVID report. This unfortunate trend even continued in the un-lockdown period and the period following that. A few patients even died in the chaos which was thus created by implementing the institutional SOP. However, none of the operated patients had any COVID-related complications.

***Limitations of the study***

Being a retrospective observational study at a single center, it gives limited assessment of the impact of the pandemic on the surgical management of sick children. A larger multi-center study would bring about stronger evidence about the impact of COVID pandemic on paediatric surgical services.

## CONCLUSION

The paediatric surgical care has been severely impacted since the declaration of COVID pandemic and subsequent implementation of lockdown; following the recent protocol frequently delayed treatment increasing morbidity and mortality and also added to the cost of treatment.

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