Original Article

Rational use of PPE during the COVID-19 pandemic: Experiences from a tertiary care center during the first phase of the pandemic in India

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Abstract

Objective: To assess the outcomes of emergent Orthopaedic procedures on clinically Covid-19 negative patients operated without PPE. **Design:** Retrospective observational study. **Methods:** Inclusion criteria: Clinically Covid-19 negative emergent/ urgent and expedited patients. **Methods:** Standard protective devices were used in the operation room (OR). No structural or workflow changes were implemented. Development of Influenza-Like Symptoms (ILI) during three weeks post-operative period were assessed. **Results:** 100 consecutive surgeries were evaluated, including 41 fractures, 19 spine surgeries, and 40 other procedures. No patient developed ILI while 13/87 doctors tested COVID RTPCR positive. Contact tracing tracked their infections to non-OR sources. All recovered with isolation and symptomatic treatment. No OR Nurse (0/26) or ancillary staff (0/30) developed ILI. **Conclusions:** In clinically Covid-19 negative patients undergoing emergent Orthopedic surgery, global PPE protection and OR restructuring is possibly unwarranted. Meticulous clinical history and examination can help conserve key resources in future pandemics of similar nature.

Key Words: COVID-19, SARS-COVID, PPE, Pandemic, Resource conservation, OR workflow

Introduction

The ongoing SARS epidemic due to the novel COVID-19 virus has virtually changed the way we live on this planet[(1)]. Needless to say, it has also influenced the way we practice, administer and teach health care in our respective societies[(2)]. India has been at the epicenter of this explosion of clinical cases of Coronavirus infection and patient mortality. Periodic changes in our preventive and therapeutic strategies only reflect the limited understanding of coping and subdue this global threat. In the USA, the CDC and the Surgeon General set out to make a series of recommendations covering all aspects of patient care[(3)]. In India, the national government and state governments have initiated measures to try and contain the spread of the virus as well as establish guidelines for treatment[(4)]. On 24th March 2020, the government of India promulgated a complete lockdown of the country. National protocols were also in place for hospital practice, like wearing PPE (personnel protective equipment), isolation of suspected patients, and aggressive disinfection protocols. Under these directives, elective surgeries were suspended indefinitely while emergent and urgent care was provided with substantial workflow modifications. Nevertheless, as we transitioned through the first and second waves of the pandemic and are on

the threshold of the third wave, our understanding of the contagion and our collective response to it has changed tremendously. The responses that were considered mandatory during the first wave to contain the spread of the disease are often less obligatory in the present situation. There are several reasons for this evolution- better understanding of the virus, its mode of spread and the immune response that it generates widespread availability of testing methodologies to identify the organism, availability, and implementation of vaccination policies, possible development of herd immunity as well as spontaneous mutations of the virus. Even in developed countries, the pandemic response was customized to the local political and economic environment as much as scientific information. Lessons learned from the worse hit, resource-constrained, low and middle-income countries[5] also add precious information on how to respond when the health care system becomes overwhelmed (WHO guidelines on the rational use of PPE dated 23rd December 2020).

This report analyses the experience from a tertiary care teaching hospital during the height of the first lockdown period (20th April to 20th June). At the time of the study, both Rapid antigen testing (RAT) and RTPCR (Reverse Transcription Polymerase Chain Reaction) testing for the virus were neither available freely nor routinely mandated by government directives. The study retrospectively analyses the outcomes of 100 consecutive emergent Orthopedic procedures on clinically COVID-19 negative patients with limited PPE for the operating staff.

This precise situation does not exist anymore in India due to the widespread testing and screening methods available; nonetheless, the study is of futuristic value since the next pandemic may represent the very first phase of the COVID-19 attack that we went through.

Materials and Methods

This retrospective observational study reports 100 consecutive patients treated surgically in the Orthopaedic department at a tertiary care facility in India. The work was approved by the Institutional Ethics Committee.

Patients

All reporting patients were categorized into five groups- emergent, urgent, expedited, short-term delayed, and long-term delayed[6]. Only the first three categories of cases were approved for surgery during the period studied. One hundred consecutive Orthopedic surgery procedures performed during the study period of 20/04/2020 to 20/06/2020 were included. Patients were preoperatively evaluated for ILI (Influenza-like illness) by the Infectious Disease Specialist before posting for the surgical procedure. Those reporting positive symptoms were excluded from the study and were treated in a designated facility.

Methods

This retrospective study was done by three Consultant level surgeons. The surgical, anesthetic, nursing team, and ancillary OR staff who came into contact with each case were listed and followed up for the study duration by the Epidemiology department familiar with contact tracing protocols.

The patients were inpatients for one week (average); at the end of the 2nd week, they were reviewed for suture removal. Thereafter, they were contacted daily until the end of the 3rd week. Those discharged earlier were additionally reviewed on day 3.

Outcome measures

All patients were followed up for three weeks post-operatively for immediate post-surgical events and ILI. They were specifically reviewed for cytokine storm like features (Hyperferritinemia, raised D-Dimer, overwhelming systemic inflammatory response, ARDS, Hemodynamic instability, and multi-organ failure), and other complications or illnesses suggestive of COVID-19 infection (fever, myalgia, fatigue, cough, shortness of breath, loss of taste and smell). All staff handling these cases during the study period were also evaluated for ILI development. The staff were additionally evaluated by COVID-19 RTPCR if clinically symptomatic.

Hospital workflow

The workflow for the cases is given in Fig 1. We did not follow the serological testing protocol as advised by Stinner et al.[7] because, at the onset of the pandemic,

such facilities were not universally available, and their usage was recommended selectively. The ILI symptoms that were sought for were fever, cough, malaise (as recommended by the WHO)[8], and atypical features of COVID-19 infection. Once established as clinically COVID-19 negative, the patients underwent an infectious disease team (ID) consultation prior to surgery. Clinically COVID-19 positive patients were redirected to a separate facility within the hospital dealing exclusively with such patients.

The Orthopaedic operative room protocol was modified to reduce risk to staff and patients during the pandemic. We continued to use the regular laminar airflow system (positive pressure system) in all our ORs[6], regional anesthesia with additional nerve blocks[9]. The OR staff was kept to the bare minimum and advised to wear N95 masks and eye protection during surgery. Due to cost constraints, green cloth reusable gowns were used (and not special impervious, disposable gowns). A waterproof plastic apron was worn inside the cloth gown where irrigation fluids were mandated. No additional PPEs were used for these clinically COVID-19 negative patients. Surgical Diathermy and power tools usage were not restricted.

Post-surgery, the patients were monitored for any ILI-related symptoms besides the surgery-specific complications. The Orthopedic staff, Anesthesia staff, and operating room personnel were also regularly monitored for ILI. Additionally, in the case of staff members, a history of contact with COVID-19 positive patients in the hospital or community was documented since several of them were assigned to additional duties in the COVID-19 center.

Results

One hundred Orthopaedic patients were operated in our hospital without additional PPE protection (other than N95 masks and eye shields) or significant OR modifications during the study period. None of the patients involved in the study showed any signs or symptoms of COVID-19 (as described in the foregoing section) during the three-week post-operative period. There was no apparent spread of COVID-19 deemed to be from blood and joint fluid by aerosol-generating surgical equipment or Diathermy (since none of the surgeons who utilized these tools tested positive for COVID-19). None of the 26 scrub nurses or the 30 ancillary OR staff exclusively involved in these surgeries tested positive during the study period. Eight Orthopaedic surgeons out of 35 who participated in the surgeries and 5 of 52 Anesthetists did test COVID-19 positive (Antigen or RTPCR) during the study period. All of them had either done duties in COVID-19 ward, intensive care, fever outpatient, or home quarantine counseling center immediately prior to their test and were ascertained to have acquired their infections from those sources rather than the OR (as determined by the contact tracing program of the ID department). All recovered with isolation and symptomatic treatment.

Three patients who had a pre-operative fever but no ILI were observed for 3-4 days and were scheduled for surgery after resolution of symptoms (COVID-19 tests were not done for these patients since they did not have any other ILI routine blood tests were normal).

At the time of this study COVID-19, antigen testing was not available, and RTPCR was restricted to symptomatic ILI patients (as per governmental and institutional directives)

The surgery list included fractures of long bones in adults & children, osteomyelitis or septic arthritis; open injuries, metastatic disease and tuberculosis of the spine with impending spinal cord compression, fracture spine, revision surgery for complications of any of the above (refer to Table 1).

There were 41 long bone fractures and 19 spine surgery procedures during the study period with a mean hospital stay of 3 days (range 2-10 days). The post-surgical status of the patient and wound were evaluated under four categories- with fever but without wound discharge [A], fever + wound serous discharge [B], without fever but wound discharge [C], and frankly septic cases with fever and pus discharge [D]. (refer to Table 2)

Discussion

As the light at the end of the tunnel is in sight, it is time to reflect on our collective learning experience and consolidate an effective strategy to combat similar

Table 1: Demographics of the 100 surgical cases

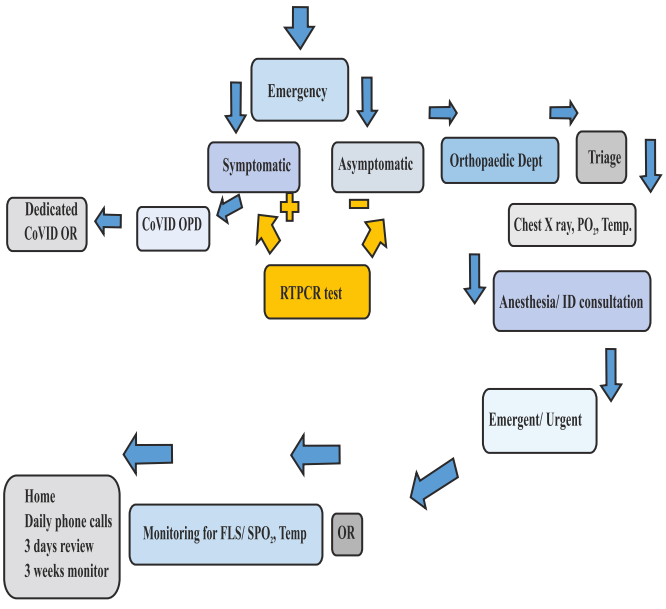
Age groups/numbers	Sex		Diagnosis				Complications			
Years [numbers]	M	F	close	open	spine	septic	A	B	C	D
10-20 [18]	12	06	14	02	00	02	01	01	01	02
20-40 [41]	30	11	24	05	10	02	02	05	02	00
40-60 [29]	21	08	16	04	08	01	00	02	02	01
Beyond 60 [12]	09	03	10	00	01	01	00	00	00	01

Table 2: Complications encountered for the 100 emergent surgeries

Case types	Fever without discharge [A]	Fever with discharge [B]	Without fever but discharge [C]	Septic [D]
Upper limb fractures-close	01	01	02	0
Upper limb fractures –open	0	01	0	01
Lower limb fractures-close	01	01	02	0
Lower limb fractures-open	0	03	0	0
Spine	01	02	0	01
Management	Resolved without additional antibiotics	Resolved after 3 days of additional antibiotics.	Resolved without additional antibiotics	Resolved after debridement and antibiotics.

events in the future[10]. The initial response was panic arising out of the inexperience in handling a contagion on this scale, spreading globally at this pace, the effective allocation of resources, and administrative challenges of policy implementation. Once the WHO declared the COVID-19 a pandemic on 11th March 2020, a series of recommendations emerged putatively to protect health care staff while caring for the victims of the virus and conserve resources against the impending unknown[11]. Massey and other workers[6] proposed selection guidelines for Orthopaedic procedures where each case was individually evaluated by the surgical, anesthetic, ID departments, as well as the OT committee. This was akin to the "pre-procedure huddle" reported by Pimentel[12] wherein all concerned personnel met up for a quick exchange before each surgery. At our institution, local guidelines were framed and practiced based on the Prachand scoring system[13] and the Iyengar's algorithm[14] adopted by the Indian Orthopedic Association during the early phase of the pandemic. The summary of the workflow that we followed is indicated in Figure 1.

Fig 1: Flowchart of action upon arrival to the emergency for Orthopaedic conditions. The blue/grey boxes indicate the work flow used in this study; the orange boxes and arrows indicate the work flow after antigen/antibody testing became available routinely.



Presently, while the first two waves of the pandemic have abated and immunization and testing facilities are freely available, it will be noted that only minimal changes to this workflow have been made- RTPCR testing has replaced clinical diagnosis based on ILS for all elective hospitalizations and pre-surgical evaluations. It may also be noted that many of the initial recommendations for OR workflow have not stood the test of time. For example, reversing the OT airflow to negative pressure has huge cost implications in developing countries and was virtually impossible in our setup. The limited use of diathermy and power tools as recommended by some authors was also found to be of uncertain benefit.

The use of PPEs to prevent the spread of highly infectious diseases is well established[15]. Cheng and co-workers[16], Livingstone et al.[17], and others have insisted on using complete PPE for all OR personnel when elective surgeries are recommenced. Evidently, such strategies have substantial cost implications. Ma has cautioned that while the resource-intensive modifications of the surgical environment are often desirable, one has to protect the "surgical ecosystem" in low- and middle-income countries in light of the pandemic[10]. Several authors[5,18-21] have called for economizing these protective resources because even developed countries have been severely challenged during the current pandemic. Our results show that none of the operating room staff affected the virus despite the limited protection measures adopted. Admittedly, though no serological tests were done on patients or personnel, none of them had ILI compared to Lei's series of 34 patients where 100% cases developed pneumonia with high mortality of 20.5%[22]. Lei and colleagues conducted their study in Wuhan itself and included all kinds of surgeries, including elective Orthopaedic, Neurosurgical, Gynaecologic, Oncologic, Gastrointestinal, Trauma, and even transplant surgeries. They do not describe pre-operative testing but do mention post-operative RTPCR tests. COVID-END, a conglomerate of evidence support organizations that encourage evidence-based decision-making in resource-constrained countries, also recommends similar conservative strategies while handling patients for surgical preparation[19].

Optimal resource management and planning are vital functions of health care administration globally[23]. This becomes even more critical in socio-economically poorer environments. The first two phases of the COVID-19 pandemic saw even first-world economies struggling under the resource crunch. The CDC has also recently updated its responses[24] depending on the resources situation into three tiers:-

1. Conventional capacity: standard infection control strategies
2. Contingency capacity: anticipated PPE shortages
3. Critical capacity: resource crunch is certain

In the light of this information, it becomes imperative to channelize our resources optimally, particularly in the face of unknown challenges.

There is a very high possibility of future pandemics with variations of these or similar organisms like Asian bird flu, Nipah virus, Chapare Virus, COVID-19 Mutants, etc.

Based on our experience, the three P's, Precautions, Personal measures, and Pre-assessment, are the keys to safe operating room practice in pandemic situations. Clinical examination and judgment have helped us to tide over through the initial days of the pandemic despite the shortage of serological testing and PPE kits. The wider application of this clinical experience would prepare us for future unknown pandemics.

This study has several limitations. It is a retrospective observational and single-center study and necessity-driven rather than a planned intervention. There is no comparison group between the protected and unprotected staff to validate our recommendations. Randomization of staff was not done as it would raise serious ethical concerns. The number of cases operated during the study period was well below the normal turnover of the institution for obvious reasons. No serological tests were performed on the patients reporting for surgery to ascertain the infection status due to the limited availability of this resource at the time of the study. We might thus have failed to detect patients who had been exposed to the virus but remained asymptomatic. But our routine theatre attire, along with

N95 masks and eyeglasses and tighter OR protocols, may have helped us to avoid the spread of infection, if any.

Inevitably, several surgical and anesthetic teams' doctors were doing emergency duties onwards and ICUs with proven COVID-19 patients as part of their rotation. Though we would have liked to exclude them, it was not possible as this is a retrospective study.

Conclusion

In view of the universally recommended rationalized use of resources, particularly in resource-challenged situations where testing facilities are unavailable or undeveloped, it seems optimal to screen patients into clinically COVID-19 positive or negative categories based on Influenza-like symptoms. Clinically negative patients may be treated as routine surgeries using standard protective wear with similar outcomes. The inventory-intensive, modified surgical facility with full PPE for all staff be used only for the clinically COVID-19 positive patients. When screening tests become widely available, they may supersede clinical assessment alone.

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Conflict of interest: Nil

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