Impact of screening COVID-19 on orthopedic trauma patients at the emergency department: A consecutive series from a level I trauma center

Hsuan-Hsiao Ma[a,b], Shang-Wen Tsai[a,b], Cheng-Fong Chen[a,b], Po-Kuei Wu[a,b], Chao-Ming Chen[a,b], Chao-Ching Chiang[a,b], Wei-Ming Chen[a,b,*]

[a]Department of Orthopaedics and Traumatology, Taipei Veterans General Hospital, Taipei, Taiwan ROC; [b]Department of Orthopaedics, School of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan, ROC

Abstract

Background: Coronavirus disease 2019 (COVID-19) posed a major threat to the clinical practice of orthopedic surgeons, especially in the emergency department. We aim to present: (1) the criteria established by the Surgery Management Committee of Taipei Veterans General Hospital in response to COVID-19 and (2) the impact of COVID-19 screening on orthopedic trauma patients in the emergency department.

Methods: From April 1 to April 30, 2020, all orthopedic trauma patients in the emergency department were screened for COVID-19 if they fulfilled any of the following: (1) travel from abroad within 14 days, (2) high-risk occupation, (3) contact or cluster history with a COVID-19–positive patient, and (4) any associated symptom, including fever up to 38°C, cough, sore throat, rhinorrhea, loss of taste or smell, muscle soreness, malaise, or shortness of breath. We recorded details on the injury, fever, management, and associated outcomes.

Results: Of the 163 orthopedic trauma patients presenting to the emergency department, 24 were screened for COVID-19; of these, 22 received surgery. Sixty-two patients received surgery without screening for COVID-19. Fever was the most common reason to screen for COVID-19 (N = 20; 83.3%). No patients were COVID-19 positive. Screened patients had a significantly longer mean interval from presentation to the emergency department to surgery (2.7 ± 2.5 vs. 1.5 ± 0.8 days, $p = 0.037$). Of the 20 patients screened because of fever, the focus was not identified in 12 (60.0%) patients. The other eight had urinary tract infection (N = 6; 27.2%), septic hip (N = 1; 4.6%), and concomitant pneumonia and urinary tract infection (N = 1; 4.6%). The mean duration of fever and hospital stay was 4.3 ± 4.6 and 8.7 ± 4.9 days, respectively. There were no thromboembolic events, surgical complications, or in-hospital mortality.

Conclusion: We developed safe and reliable screening criteria for this COVID-19 pandemic. The delay in surgery was reasonable and did not adversely affect in-patient outcomes.

Keywords: Coronavirus; COVID-19; Emergency service, hospital; Fever; Taiwan; Trauma

1. INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2), which is highly contagious and has presented major threats to global health and economic systems.[1] The initial outbreak of COVID-19 was from Wuhan, Hubei, China, and from there the disease spread widely to other countries, such as Thailand, Japan, Korea, Vietnam, Germany, the United States, and Singapore. The first case in Taiwan was reported on January 21, 2020. The World Health Organization (WHO) issued a Public Health Emergencies of International Concern alarm on January 30, 2020,[2] and recent global data from WHO showed 50 030 121 confirmed cases with 1 252 072 deaths as of November 9, 2020.[3]

Since the first death in Taiwan on February 16, the source of the majority of cases has changed from importation to suspected local transmission.[4] Thus, widespread community transmission was anticipated. Although the services of elective and emergent orthopedic surgery were reduced during this COVID-19 pandemic,[5] the impact on our practice in the emergency department was also potentially significant. Criteria were needed to screen orthopedic trauma patients for COVID-19 in the emergency department, especially for those patients who needed to receive surgery. As one of the largest tertiary trauma centers in Northern Taiwan, our hospital modified our clinical criteria for COVID-19 screening until the end of March, when a final version was decided upon and applied to all patients who came to the emergency department. In this study, we aim to present the criteria, results, and impact of screening for COVID-19 on orthopedic trauma patients in the emergency department.

*Address correspondence. Dr. Wei-Ming Chen, Department of Orthopaedics and Traumatology, Taipei Veterans General Hospital, 201, Section 2, Shi-Pai Road, Taipei 112, Taiwan, ROC. E-mail address: wmchen2499.vghtpe@gmail.com (W.-M. Chen).

Dr. Wei-Ming Chen, an editor at Journal of the Chinese Medical Association, had no role in the peer review process of or decision to publish this article.

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

Journal of Chinese Medical Association. (2021) 84: 423-427.

Received August 4, 2020; accepted November 19, 2020.

doi: 10.1097/JCMA.0000000000000503.

2. METHODS

2.1. Patient selection

We conducted a retrospective, observational study in a tertiary trauma center from April 1, 2020 to April 30, 2020. This study was approved by our institutional review board. All patients who came to the emergency department with orthopedic trauma during this study period were eligible for assessment (N = 163). According to our screening criteria, 24 patients (14.7%) received COVID-19 rapid screening test, whereas the other 139 patients did not. Twenty-two of the 24 patients underwent surgery for their injuries. The other two patients were treated conservatively and discharged from the emergency department. Of the 139 patients who were not screened for COVID-19, 62 received surgery and the other 77 received conservative treatment (Fig. 1, CONSORT).

2.2. Criteria for screening

The first patient diagnosed with COVID-19 in Taiwan was reported on January 21, 2020. From January 21, 2020 to March 31, 2020, the Surgery Management Committee of Taipei Veterans General Hospital developed the screening criteria for COVID-19: positive history of travel, occupation, contact, or cluster (TOCC) AND associated symptoms. The definition of positive TOCC history included travel history to level-3 countries within 14 days, high-risk occupation, contact or cluster history. The associated symptoms included fever up to 38°C, cough, sore throat, rhinorrhea, loss of taste or smell, muscle soreness, malaise, or shortness of breath.

The number of infected patients and the risk of community spread were both significantly increased by the end of March 2020. The Surgery Management Committee of Taipei Veterans General Hospital then revised the screening criteria for COVID-19 from "positive TOCC history AND associated symptoms" to "positive TOCC history OR associated symptoms." Moreover, the definition of travel history was expanded from level-3 countries to all foreign countries.

If the patient's condition fulfilled any one of the aforementioned criteria, we checked the real-time reverse transcription polymerase chain reaction of a nasopharyngeal swab and sputum tests for SARS-CoV-2. The interval from obtaining the specimens to obtaining the laboratory results was about 6 hours. Moreover, chest radiograph, laboratory examinations (such as complete blood count and biochemistry tests), and urine analysis were also arranged as indicated. Each patient was isolated until we validated a negative COVID-19 result. We arranged for surgery if the patient fulfilled the following criteria: (1) a negative result for COVID-19 and (2) no other fever focus could be detected (eg, urinalysis or chest radiograph). If there was a positive COVID-19 result, the patient was transferred to the negative pressure isolation ward for care. Infection and chest specialists were consulted for a further treatment plan for COVID-19 and the possible time point for surgery.

2.3. Data collection

Twenty-four orthopedic trauma patients underwent rapid screen testing for COVID-19 and 22 received surgery. There were 11 (50.0%) male and 11 (50.0%) female patients. Mean age was 59.2 ± 24.3 (range, 6-92) years. With regard to clinical characteristics, we recorded the Charlson's Comorbidity Index (CCI), Injury Severity Score (ISS), injury site, associated injury, and procedures performed. To evaluate the impact of COVID-19 screening, we recorded the reason for COVID-19 screening, the interval from admission to the emergency department to the start of surgery, duration of fever, fever focus, and length of hospital stay.

2.4. Statistical analysis

Data were analyzed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Data were represented as mean ± SD or median and range for continuous variables, or number and percentage for categorical variables. The Fisher's exact test and independent *t* test were used to compare differences between groups for each discrete variable. A value of $p < 0.05$ was considered to represent statistical significance.

3. RESULTS

Twenty-four of 163 (14.7%) orthopedic trauma patients presenting to the emergency department were screened for COVID-19. The reasons for screening included fever (N = 20; 83.3%), upper respiratory tract symptoms (N = 3; 12.5%), and travel history (N = 1; 4.2%). Of the 24 patients screened for COVID-19,

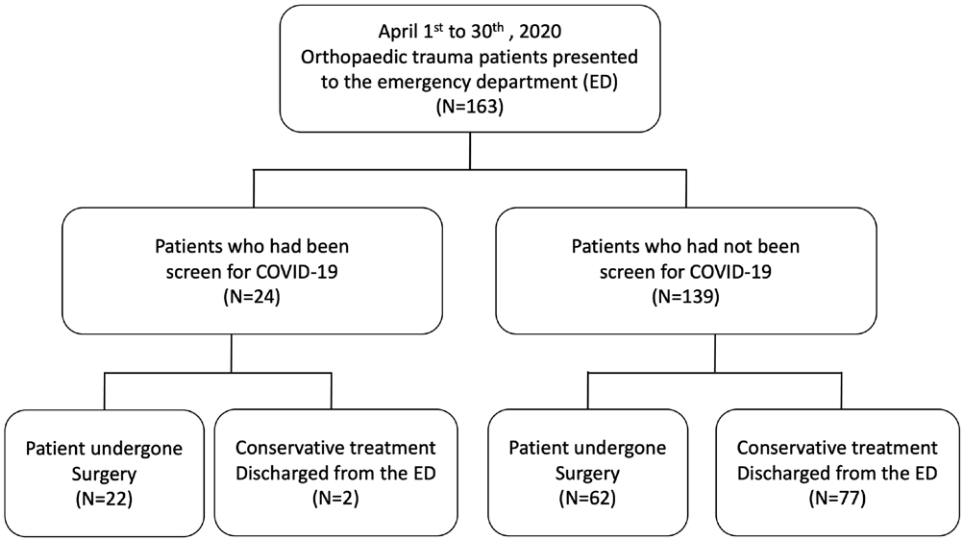

Fig. 1. CONSORT flow diagram. COVID-19 = coronavirus disease 2019.

Table 1

Clinical characteristics of orthopedic trauma patients who had or had not been screened for COVID-19

	Screen for COVID-19 (N = 22)	Not screen for COVID-19 (N = 62)	*p* value
Age, y	59.2 ± 24.3	56.8 ± 22.9	0.675
Sex			0.513
Male	11 (50%)	36(58%)	
Female	11 (50%)	26(42%)	
Charlson's Comorbidity Index	2.7 ± 1.9	3.5 ± 3.7	0.189
Injury Severity Score	10.0 ± 3.7	4.3 ± 3.1	<0.001
Interval from ED to surgery, d	2.7 ± 2.5	1.5 ± 0.8	0.037
Injury site			0.311
Upper extremity fracture	5 (22.7%)	23 (37.1%)	
Lower extremity fracture	10 (45.5%)	14 (22.6%)	
Osteoporotic hip fracture	5 (22.7%)	14 (22.6%)	
Multiple trauma	1 (4.5%)	5 (8.1%)	
Others	1 (4.5%)	6 (9.6%)	
Length of hospital stay, d	8.7 ± 4.9	5.7 ± 4.8	0.017

COVID-19 = coronavirus disease 2019; ED = emergent department; Others = soft tissue injuries, including tendon ruptures.

22 received surgery. During the same period, another 62 patients underwent surgery without being screened for COVID-19. Mean age, sex distribution, and CCI did not differ between the two cohorts. Patients who had been screened for COVID-19 had significantly longer intervals from admittance to the emergency department to their time of surgery (2.7 ± 2.5 vs. 1.5 ± 0.8 days, $p = 0.037$). Patients screened for COVID-19 also had significantly longer hospital stays (8.7 ± 4.9 vs. 5.7 ± 4.8 days, $p = 0.017$), possibly because of their significantly higher ISS (10.0 ± 3.7 vs. 4.3 ± 3.1, $p < 0.001$). Because all the screening results for COVID-19 were negative, the increased length of hospital stay might have been associated with the treatment for the injury, not COVID-19 (Table 1).

The injury sites of the 22 patients who had undergone surgery after screening for COVID-19 included lower extremity fractures (N = 10; 45.5%), senile hip fractures (N = 5; 22.7%), upper extremity fractures (N = 5; 22.7%), multiple fractures (N = 1; 4.6%), and quadriceps tendon rupture (N = 1; 4.6%). Six (27.2%) patients had other associated injuries, including rib fractures, head injuries, or facial bone fractures (Table 2).

For the patients screened for COVID-19 who had undergone surgery, the mean duration of fever was 4.3 ± 4.6 (range, 1-19) days. None of these patients had a positive screening result for COVID-19. We found positive fever focus in only 8 (36.3%) patients, including urinary tract infection (N = 6), septic hip (N = 1), and concomitant urinary tract infection and pneumonia (N = 1). The fever focus remained unknown until discharge in the other 12 patients (60.0%), but fever in all 20 patients subsided before discharge. The average length of hospital stay was 8.7 ± 4.9 (range, 2-20) days (Table 2). There were no thromboembolic events, surgical complications, or in-hospital mortality. None of these 163 patients were subsequently diagnosed with COVID-19 based on data from Taiwan Centers for Disease Control (Taiwan-CDC).

4. DISCUSSION

In this study, we validated the impact of screening COVID-19 on orthopedic trauma patients in the emergency department during the COVID-19 pandemic. A substantial proportion of patients (N = 24; 14.7%) fulfilled the criteria for screening for COVID-19, with fever as the most common reason (N = 20; 83.3%). On average, the fever lasted for 4.3 days. However, no fever focus could be identified in 60% of patients after a thorough survey. COVID-19 screening was associated with a delay of 2.7 days from admittance to the emergency department to time of surgery. Despite that significant delay, no thromboembolic events, surgical complications, or in-hospital mortality was noted.

Although the clinical manifestations of COVID-19 can be varied,[6–8] fever (83.3%) and upper airway respiratory symptoms (60.3%) are the most common.[9] According to a study of trauma patients, up to 40% of patients who had experienced trauma and were sent to the emergent department had fever symptoms during the first 48 hours after admission, possibly a manifestation of the stress response. Despite a thorough workup for fever, no source of infection was found in 70% of febrile patients.[10] In our study, we found a similar rate of negative results of fever workup (60%). Fever, a common presentation in trauma patients, can be very stressful to medical personnel during a COVID-19 pandemic, who are the medical practitioners at highest risk of being exposed and infected.[11–15] Therefore, the need to screen for COVID-19 in orthopedic trauma patients involves more than the ability to diagnose COVID-19; such patients must be screened to help protect these most vulnerable medical personnel, because this population will often require surgery. This is also why we did not list radiographic features based on chest radiograph or computed tomography as one of the criteria for screening, although that information has proven helpful.[9,16] To address the global pandemic nature of COVID-19 infection, we added TOCC history to our criteria for screening, even if the patients were asymptomatic.

Although Taiwan had been expected to have the second highest number of COVID-19 cases due to its location near China,[17] the epidemic seemed to slow down, because there were no new cases for the 13 days before May 20. We should attribute this preliminary success to the early recognition by our government of the crisis and its proper management of the imported cases. The screening strategy can differ from that used in situations with a community spread. A more comprehensive screening strategy for COVID-19 might be necessary in areas with community spread, whereas a more specific strategy can be formulated in places where local, second-generation, or third-generation cases are rare, such as in Taiwan.[18–20] Based on our screening criteria, results from the 22 patients who underwent surgery were negative for COVID-19. Because of this negative result, the delay from the emergency department to surgery was reasonable (2.7 days). Notably, none of these patients experienced thromboembolic events, surgical complications, or in-hospital mortality. In comparison, a longer delay from injury to surgery (8.7 days) because of positive COVID-19 screening results might be associated with adverse outcomes such as cardiovascular events, thromboembolism, or pneumonia.[21]

Our study has some limitations. First, this study had such a small sample size because the protocol was started after the outbreak of local transmission. Second, although the investigated hospital was one of the designated hospitals for receiving COVID-19 suspect cases from primary care, none of the orthopedic trauma patients were diagnosed with COVID-19 based on our screening protocol. Third, although the diagnostic testing in the investigated hospital was approved by the Taiwan-CDC, the sensitivity and specificity of the assay are unknown at present.

In conclusion, our criteria to screen for COVID-19 in orthopedic trauma patients appears safe and reliable. There was a reasonable delay in surgery, but it did not adversely affect the in-patient outcomes.

Table 2

Clinical information of patients who had been screened for COVID-19 at ED before receiving surgery

Patient number	Age/sex	CCI	ISS	Interval from ED to surgery, d	Injury site	Procedure	Associated injury	Duration of fever, d	Fever focus	Length of hospital stay, d	Reason for screening
1	80/female	6	9	2	Femoral neck fracture	ORIF	Nil	–	–	4	Positive TOCC history
2	85/female	4	9	1	Distal femur fracture	ORIF + TKA	Nil	16	UTI	17	Fever
3	65/male	2	19	11	Distal clavicle fracture	ORIF	Rib fracture	2	Unknown	15	Fever
4	62/female	2	9	1	Forearm fracture	ORIF	Nil	3	UTI	6	Fever
5	55/male	4	9	3	Femoral neck fracture with septic hip	THA	Nil	4	Septic hip	8	Fever
6	79/female	3	9	3	Tibia shaft fracture	ORIF	Nil	4	Unknown	8	Fever
7	28/male	0	11	2	Distal radius fracture	ORIF	Nil	2	Unknown	3	Fever + headache + upper respiratory tract symptoms
8	57/female	1	9	1	Tibial plateau fracture	ESF/ORIF	Head injury	6	Unknown	13	Fever + upper respiratory tract symptoms
9	25/male	0	4	2	AC dislocation	ORIF	Nil	2	Unknown	6	Fever
10	53/female	1	9	1	Distal radius fracture	ORIF	Nil	2	Unknown	4	Fever
11	86/male	5	9	3	Femoral neck fracture	ORIF	Nil	1	Unknown	15	Fever
12	35/female	2	9	1	Femoral neck fracture	ORIF	Nil	3	UTI	5	Fever
13	78/female	3	10	2	Tibial plateau fracture	ORIF	Head injury	3	UTI	11	Fever
14	92/male	6	9	4	Femoral neck fracture	HA	Nil	6	UTI + pneumonia	13	Fever
15	19/male	0	14	2	Femoral shaft fracture	ORIF	Facial bone fracture + head injury	7	Unknown	9	Fever
16	75/male	4	9	8	Pelvis fracture	ORIF	Facial bone fracture + head injury	1	Unknown	10	Fever
17	6/male	0	9	0	Femoral shaft fracture	ORIF	Nil	–	–	2	Upper respiratory tract symptoms
18	79/female	4	13	1	Distal femur fracture	ORIF	Nil	2	Unknown	5	Fever
19	67/male	2	9	2	Femoral neck fracture	HA	Nil	3	UTI	6	Fever
20	74/female	4	9	3	Femoral shaft fracture	ORIF	Nil	4	UTI	6	Fever
21	60/female	2	20	3	Clavicle fracture, tibial fracture	ORIF	SAH	19	Unknown	20	Fever
22	42/male	4	4	3	Quadriceps tendon rupture	Repair	Nil	3	Unknown	6	Fever

AC = acromioclavicular; CCI = Charlson's Comorbidity Index; COVID-19 = coronavirus disease 2019; ED = emergent department; ESF = external skeletal fixation; HA = hemiarthroplasty; ISS = Injury Severity Score; ORIF = open reduction and internal fixation; SAH = subarachnoid hemorrhage; THA = total hip arthroplasty; TKA = total knee arthroplasty; TOCC = travel, occupation, contact or cluster; UTI = urinary tract infection.

REFERENCES

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;**395**:497–506.
2. Wu YC, Chen CS, Chan YJ. The outbreak of COVID-19: an overview. *J Chin Med Assoc* 2020;**83**:217–20.
3. World Health Organization. WHO coronavirus disease (COVID-19) dashboard. Available at https://covid19. who. int. Accessed 2020.
4. Cheng HY, Li SY, Yang CH. Initial rapid and proactive response for the COVID-19 outbreak—Taiwan's experience. *J Formos Med Assoc* 2020;**119**:771–3.
5. Wong JSH, Cheung KMC. Impact of COVID-19 on orthopaedic and trauma service: an epidemiological study. *J Bone Joint Surg Am* 2020;**102**:e80.
6. Su YB, Kuo MJ, Lin TY, Chien CS, Yang YP, Chou SJ, et al. Cardiovascular manifestation and treatment in COVID-19. *J Chin Med Assoc* 2020;**83**:704–9.
7. Lee IC, Huo TI, Huang YH. Gastrointestinal and liver manifestations in patients with COVID-19. *J Chin Med Assoc* 2020;**83**:521–3.
8. Jeng MJ. Coronavirus disease 2019 in children: current status. *J Chin Med Assoc* 2020;**83**:527–33.
9. Fu L, Wang B, Yuan T, Chen X, Ao Y, Fitzpatrick T, et al. Clinical characteristics of coronavirus disease 2019 (COVID-19) in China: a systematic review and meta-analysis. *J Infect* 2020;**80**:656–65.
10. Bengualid V, Talari G, Rubin D, Albaeni A, Ciubotaru RL, Berger J. Fever in trauma patients: evaluation of risk factors, including traumatic brain injury. *Am J Crit Care* 2015;**24**:e1–5.
11. Tseng JY, Lai HY. Protecting against COVID-19 aerosol infection during intubation. *J Chin Med Assoc* 2020;**83**:582.
12. Yang CY, Wang YF, Ho Y, Wu CH, Lee CY, Tarng DC. Hemodialysis vascular access care during the COVID-19 pandemic. *J Chin Med Assoc* 2020;**83**:634–8.
13. Chen MJ, Chang KJ, Hsu CC, Lin PY, Liu C JL. Precaution and prevention of coronavirus disease 2019 infection in the eye. *J Chin Med Assoc* 2020;**83**:648–50.
14. Li SY, Tang YS, Chan YJ, Tarng DC. Impact of the COVID-19 pandemic on the management of patients with end-stage renal disease. *J Chin Med Assoc* 2020;**83**:628–33.
15. Wu YC, Chen CS, Chan YJ. Reply to "protecting against COVID-19 aerosol infection during intubation". *J Chin Med Assoc* 2020;**83**:583.
16. Chen SG, Chen JY, Yang YP, Chien CS, Wang ML, Lin LT. Use of radiographic features in COVID-19 diagnosis: challenges and perspectives. *J Chin Med Assoc* 2020;**83**:644–7.
17. Wang CJ, Ng CY, Brook RH. Response to COVID-19 in Taiwan: big data analytics, new technology, and proactive testing. *JAMA* 2020;**323**:1341–2.
18. Kim JY, Choe PG, Oh Y, Oh KJ, Kim J, Park SJ, et al. The first case of 2019 novel coronavirus pneumonia imported into Korea from Wuhan, China: implication for infection prevention and control measures. *J Korean Med Sci* 2020;**35**:e61.
19. Navarro RA, Reddy NC, Weiss JM, Yates AJ Jr, Fu FH, McKee M, et al. Orthopaedic systems response to and return from the COVID-19 pandemic: lessons for future crisis management. *J Bone Joint Surg Am* 2020;**102**:e75.
20. Chen P, Zhang Y, Wen Y, Guo J, Jia J, Ma Y, et al. Epidemiological and clinical characteristics of 136 cases of COVID-19 in main district of Chongqing. *J Formos Med Assoc* 2020;**119**:1180–4.
21. Meng Y, Leng K, Shan L, Guo M, Zhou J, Tian Q, et al. A clinical pathway for pre-operative screening of COVID-19 and its influence on clinical outcome in patients with traumatic fractures. *Int Orthop* 2020;**44**:1549–55.