



Case Series

Impact of the COVID-19 pandemic on the management of chronic limb-threatening ischemia in Northern Jordan: Case series and literature review



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ABSTRACT

INTRODUCTION: The novel COVID-19 pandemic has imposed unprecedented restrictions on healthcare services worldwide. In developing nations such as Jordan, appreciable impacts on healthcare delivery ensued owing to limited resources. As a result, managing chronic limb-threatening ischemia (CLTI) has been modified to accommodate alterations in the system. This study assessed the impact of the COVID-19 pandemic on managing patients with critical limb-threatening ischemia (CLTI) during the lockdown.

METHODS: Objectives were accomplished by retrieving records of clinical data and perioperative results for patients diagnosed with CLTI at King Abdullah University Hospital between March 17 and June 1, 2020. Patients' demographics, Rutherford classification, type of intervention, and intervention variables during the outbreak were retrospectively analyzed (pandemic Group A) and compared with patients from the same period last year (control Group B).

RESULTS: A total of 96 patients with CLTI were included in the study; Groups A and B consisted of 28 and 68 patients, respectively. The mean ages for Groups A and B were 62.8 and 60.2 years, respectively. Conservative management was applied to 53.6% ($P < 0.01$) of Group A patients, whereas endovascular revascularization was the primary approach in Group B (39.7%, $P < 0.01$). After the intervention, the majority of patients in Group A were classified as category six on the Rutherford classification system (46.4%, $P < 0.01$), whereas the majority in group B were classified as category five (55.9%, $P < 0.01$).

CONCLUSIONS: The more unsatisfactory outcome of CLTI during the pandemic entails substantial measures to ensure conscientious virtual encounters and ambulatory community-based services during current and future pandemics. The endovascular-first policy should be endorsed in future pandemics as it is better at reducing aerosol transmission than standard surgical intervention. Moreover, endovascular procedures are minimally invasive and associated with favorable outcomes when medical optimization and hospital beds are limited.

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Abbreviations: PAD, peripheral arterial disease; CLTI, critical limb-threatening ischemia; LoS, length of stay; MLEA, major lower-extremity amputation; DFU, diabetic foot ulcers.

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1. Introduction

The COVID-19 pandemic has undoubtedly affected the functioning of society and brought unified grief of losing what we all took for granted. The Greek philosopher Epictetus said, "He is a wise man who does not grieve for the things he has not but rejoices for those he has". As a developing country, Jordan faces many challenges due to the new rules stemming from lockdown measures that were implemented on March 17, 2020, to control the spread of the disease. Since then, the rules associated with vascular surg-

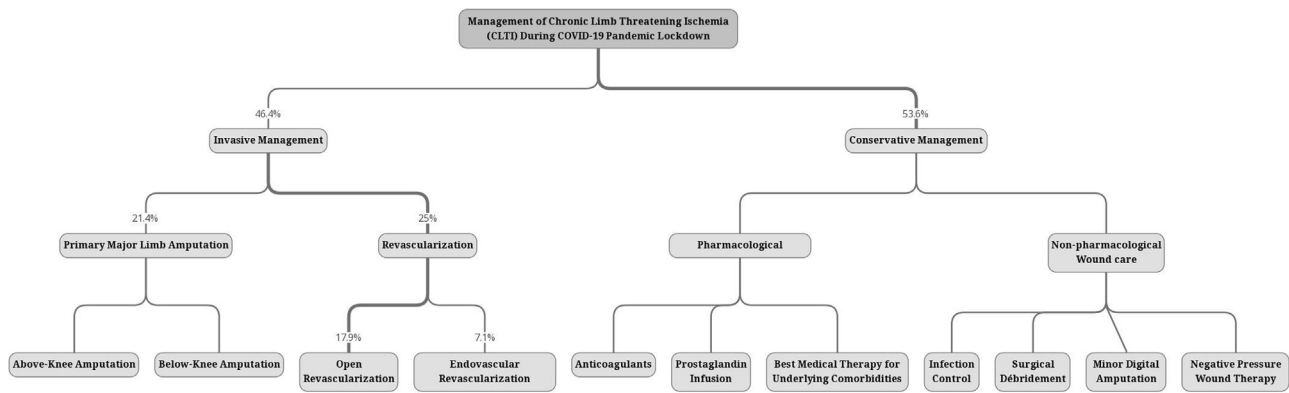


Fig. 1. Flow chart of Chronic Limb Threatening Ischemia (CLTI) management during the COVID-19 pandemic.

eries, including those related to peripheral arterial disease (PAD), have become more stringent. These rules are based on the guidance provided by the American College of Surgeons and the Vascular Society of Great Britain and Ireland [1,2].

PAD is an atherosclerotic disease characterized by stenotic or occlusive disruption of blood flow to the extremities. Features of its end-stage form, known as critical limb-threatening ischemia (CLTI), include recurring lower-extremity night or rest pain, subsequent limb ulceration, and gangrene with potential escalated risks of cardiovascular events, amputation, and death. Owing to the patient’s high-risk comorbidity profile and critical status upon presentation, CLTI treatment requires an integrated multidisciplinary approach involving various subspecialties. Consequently, the National Health Service in England has classified CLTI as a condition requiring urgent intervention through radiological approaches or amputation, especially in those with critically threatened leg(s) [3]. Nevertheless, international guidelines [1] published during the COVID-19 pandemic encourage conservative management for CLTI. This approach can be a practical option for patients without access to revascularization opportunities or for patients in a fragile state or who present with substantial comorbidities [4]. Accordingly, our hospital has deferred elective procedures, venous surgeries, and the treatment of asymptomatic conditions requiring intervention. Besides, we have been implementing as much conservative management as possible in an effort to prioritize resources toward the surge of patients diagnosed with COVID-19. In light of such adaptations, this study aimed to assess the impact of the COVID-19 pandemic on the management of patients with CLTI during the lockdown compared to our practice before the outbreak.

2. Methods

2.1. Study setting

We retrospectively examined the demographics and other characteristics of patients with CLTI during the COVID-19 outbreak between March 17 and June 1, 2020 (Group A) and compared the results with patients from the same period in the previous year (Group B). Specifically, we extracted the following data from our university hospital electronic medical records: patients’ demographics, Rutherford Classification, type of intervention, length of stay (LoS), 30-day readmission, and 30-day mortality. Informed consent was obtained from each patient. The authors reported the data in line with the SCARE 2020 criteria [5].

2.2. Study design

In our department, management of CLTI during the COVID-19 pandemic mainly involved non-surgical conservative manage-

ment that includes pharmacological and non-pharmacological approaches (Fig. 1). Pharmacological treatment included anticoagulants, prostaglandin infusion, and the best available medical therapy for underlying comorbidities. Non-pharmacological treatments included supplementary wound care methods consisting of infection control, surgical debridement, minor digital amputation, and negative pressure wound therapy, which were implemented when necessary. Regrettably, smoking cessation services are limited and underdeveloped in Jordan. The invasive intervention included revascularization procedures or primary major lower-extremity amputation (MLEA). Primary MLEA, which was reserved for late or progressive stages of CLTI, involved major amputation above or below the knee without an antecedent open or endovascular attempt at limb salvage.

According to the Global Guidelines [6], after the appropriate therapy, we classified CLTI under the Rutherford system as Categories 4 (rest pain only), 5 (minor tissue loss with an ischemic non-healing ulcer or focal gangrene with diffuse pedal ischemia), and 6 (tissue loss extending above the transmetatarsal with a non-salvageable functional foot).

2.3. Statistical analysis

Continuous numeric variables are expressed as mean ± standard deviation, whereas categorical variables are described using frequencies and percentages. Means of continuous variables were compared using independent t-tests, with $P < 0.05$ indicating a statistically significant difference. Categorical variables were compared using Pearson’s chi-square test of association. If the association between categorical variables yielded a P -value < 0.05 , then a *post hoc* residual analysis was conducted to determine the exact significance in the contingency table.

3. Results

The control and pandemic groups consisted of 68 and 28 CLTI patients, respectively. Both groups shared similar demographic features (Table 1). The most interesting contrast between the two groups is the less favorable Rutherford category of patients in the pandemic group, where 46.6% of patients were classified as category 6, compared to 2.9% of patients in the control group ($P < 0.01$). Moreover, patients admitted during the pandemic were more likely to be managed conservatively (53.6%, $P < 0.01$), despite a higher Rutherford classification than the control group. Surprisingly, open revascularization was performed 2.5 times more frequently than endovascular revascularization in the Pandemic Group. For one-fifth of pandemic patients, the definitive management was primary MLEA. Two CLTI patients (7.1%) died during the lockdown.

Table 1
Baseline patient characteristics and outcome results.

Compared Variables ^a	Pandemic Group A	Control Group B	P
Number of Patients with CLTI	28	68	–
Age, mean ± SD (y)	62.8 ± 12.3	60.2 ± 12.5	NS
Male	25 (89.3%)	54 (79.4%)	NS
Diabetic	24 (85.7%)	59 (86.8%)	NS
Smoking	21 (75.0%)	43 (63.2%)	NS
Intervention			
Conservative treatment	15 (53.6%)	15 (22.1%)	<0.01
Open Revascularization	5 (17.9%)	16 (23.5%)	NS
Endo Revascularization	2 (7.1%)	27 (39.7%)	<0.01
Primary Major Amputation	6 (21.4%)	10 (14.7%)	NS
Rutherford Classification			
Rutherford 4	10 (35.7%)	28 (41.2%)	NS
Rutherford 5	5 (17.9%)	38 (55.9%)	<0.01
Rutherford 6	13 (46.4%)	2 (2.9%)	<0.01
Intervention variables			
Length of Stay (days)	13.2	9.1	NS
30-day readmission	7 (25.0%)	15 (22.1%)	NS
30-day mortality	2 (7.1%)	N/A	N/A

CLTI: Chronic Limb Threatening Ischemia.

NS: Not Significant.

N/A: Not Applicable.

^a Categorical and continuous variables are presented as percentages and mean ± standard deviation, respectively. Categorical variables across groups were compared using Pearson's χ^2 test or Fisher's exact test. Across-group comparison of means was accomplished using analysis of variance. *P* values < 0.05 are considered statistically significant.

4. Discussion

Options for treating CLTI within the healthcare system have undergone unprecedented restrictions worldwide. Our hospital, a tertiary academic institution, has been responsible for dealing with COVID-19 patients in the northern region of Jordan. To accommodate these patients, cases that were non-urgent or non-limb-threatening were postponed and discharged. Only urgent patients were seen in person. We deferred elective procedures, redistributed most ICU beds, redirected medical resources towards handling the outbreak, and increased conservative management approaches by two-fold. During the pandemic, patients were generally reluctant to seek medical attention due to fear of contracting the virus, resulting in late presentation to emergency centers [7]. Thus, 46.6% of our pandemic cohort were classified as Rutherford category 6 instead of only 2.9% in the control group. Despite the more severe Rutherford category of the pandemic group, essential surgical delivery for this group was restricted owing to understaffing and redeployment of key vascular personnel, difficulty in liaising between different healthcare departments, overburdened supply chain, and increased demand in critical care beds to accommodate the COVID-19 patients [7].

The lockdown resulted in shortages of essential supplies that prevented timely interventions for vascular patients. In particular, lockdown measures negatively affected the logistics required for the endovascular-first approach for CLTI patients, which is recommended over the more accessible open revascularization methods. The endovascular-first approach is recommended by various vascular societies when invasive revascularization interventions are required. The approach taken at our hospital does not reflect CLTI management in other hospitals. For example, a recent analysis from Madrid reveals that during the pandemic, 44% of revascularizations were performed using complete endovascular methods, whereas 39% of them were achieved by complete open revascularization [8]. The endovascular approach minimizes the need for a multidisciplinary input; additionally, its outcome is generally favorable in terms of morbidity and mortality [9]. Moreover, a lower level of medical optimization is required, as endovascular revasculariza-

tion is performed under regional or loco-regional anesthesia, which reduces the generation of aerosols in the operating theater [9].

Regardless of the mode of management, CLTI is a life-threatening disease that substantially results in a dismal outcome. The impact of delayed and conservative management of CLTI during the pandemic should be considered during the expected surge of patients with adverse vascular conditions post-pandemic. Moreover, the risks associated with the postponed elective interventions during the pandemic should be stratified to avoid the anticipated backlog of interventions and possible disease progression. At the time this article was being written, we were experiencing a post-lockdown surge of severely ill patients. Thus far, one-third of our patients with advanced Rutherford categories have undergone debilitating MLEA, and one patient has died of the disease.

The death of two patients (7%) during the lockdown can be attributed to delayed presentation, their advanced age, and accompanying comorbidities. Under normal circumstances, such cases require a multidisciplinary approach for proper treatment. At the time of the outbreak, however, medical interventions were often delayed and substandard. This is consistent with the findings of Li et al. [10], who reported that perioperative death constituted 6.7% of patients with PAD undergoing surgery. By contrast, a meta-analysis conducted in 2013 indicates that the 30-day mortality figures for open revascularization and endovascular treatment procedures are 2.6% and 0.7%, respectively [11]. Because of the retrospective nature of data collection in this study, we could not obtain the 30-day mortality rate for the control group.

The LoS and readmission rates were higher in the pandemic group, although the difference with the control group was not statistically significant. This can be explained by our recently recorded mortality rate, which decreased the LoS, thus skewing the statistical results [12]. In addition, the lack of outpatient clinic follow-up and ambulatory podiatry services during lockdown may have also contributed to increased LoS. Overall, the total number of hospital days (including primary admission and subsequent readmission days) was notably higher in the pandemic group compared to the control group.

Patients who suffer from various chronic ailments often have restricted mobility, which is an obstacle toward visiting medical doctors personally. Our study provides evidence that not getting medical assistance for extended periods can exacerbate existing conditions. If available, consultations through telemedicine can greatly benefit chronically ill patients who continue to require medical attention during this troubling period [13,14]. Notably, a recent analysis by Shin et al. [13] proved that vigilant telemedicine and an ambulatory podiatry service reduced the rate of hospitalization for diabetic foot ulcers (DFU) during the current pandemic. The authors propose the need to modify the current guidelines for DFU management. However, developing countries often lack the resources for telemedicine, community-based care, smoking cessation quitlines, and ambulatory podiatry services, which have a significant impact on patients with CLTI [13]. The dismal outcome, often associated with CLTI, requires that substantial measures be taken, especially during pandemics, to mitigate disease progression. In Jordan, we recommend implementing conscientious virtual encounters (e.g., telemedicine) and ambulatory community-based services.

5. Conclusions

The more unsatisfactory outcome of CLTI during the pandemic entails substantial measures to ensure conscientious virtual encounters and ambulatory community-based services during current and future pandemics. The endovascular-first policy should be endorsed in future pandemics as it is better at reducing aerosol transmission than standard surgical intervention.

Moreover, endovascular procedures are minimally invasive and associated with favorable outcomes when medical optimization and hospital beds are limited.

Declaration of Competing Interest

The authors report no declarations of interest.

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None.

Ethical approval

This study was approved by the institutional review board committee at Jordan University of Science and Technology, Jordan (# 467–2020).

Consent

For this study, formal and informed consent were waived since data was used in aggregate with no personal identifiers. The authors did not include case details or any personal information or images of the patients. The study was conducted with assurance of patient confidentiality and in accordance with the Declaration of Helsinki and its later amendments for ethical research performance.

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Registration of research studies

Not Applicable.

Guarantor

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Provenance and peer review

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CRedit authorship contribution statement

Qusai Aljarrah: Writing - review & editing. **Mohammed Allouh:** Data curation. **Amer Hallak:** Formal analysis. **Mamoon Al-Omari:** Conceptualization. **Zaid Mesmar:** Investigation. **Ahmad Kamel:** Investigation. **Anas Husein:** Investigation. **Tarek Manasreh:** Writing - original draft. **Sohail Bakkar:** Supervision. **Hamza Jarboa:** Writing - original draft.

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