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Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

Redefining diabetic foot disease management service during COVID-19 pandemic

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ARTICLE INFO

Article history:

Received 23 May 2020

Received in revised form

8 June 2020

Accepted 10 June 2020

Keywords:

COVID-19

Coronavirus

Pandemics

Diabetes mellitus

Diabetic foot

ABSTRACT

Background & aims: Diabetic Foot Disease (DFD) management had to be redefined during COVID-19. We aim to evaluate the impact of this on diabetic foot care services and the strategies adopted to mitigate them.

Methods: We have performed a comprehensive review of the literature using suitable keywords on the Search engines of PubMed, SCOPUS, Google Scholar and Research Gate in the first two weeks of May 2020. We have reviewed how the diabetic foot service in the hospital and community setting has been affected by the current Coronavirus outbreak.

Results: We found considerable disruption in diabetic foot service provisions both in the primary care and in the hospital settings. Social distancing and shielding public health guidelines have impacted the delivery of diabetic foot services.

Conclusion: As the COVID-19 pandemic spreads worldwide, health care systems are facing the tough challenges in delivering diabetic foot service to patients. Public health guidelines and the risk of virus transmission have resulted in reconfiguration of methods to support and manage diabetic foot patients including remote consultations.

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1. Introduction

The novel Coronavirus (2019-nCoV) crisis started in Wuhan, China in December 2019 [1] and has spread globally. At the World Health Organisation latest report, there were over 6.5 million confirmed cases of COVID-19 in over 210 countries accounting for more than 397,000 deaths (06 June 2020) [2].

The global outbreak of this disease has led to the suspension of most routine clinical work as all healthcare resources are mobilised to fight the pandemic. There have been significant efforts made to enforce social distancing and to reduce attendances to primary and secondary care facilities. This has had a significant impact on patients with significant co-morbidities, in particular for those with diabetes mellitus (DM) and associated foot involvement. We wanted to ascertain the affect this has had on Diabetic Foot Disease

(DFD) services and the steps taken by health care organisation to support these patients.

2. Overview of diabetic foot disease (DFD)

Diabetic foot is defined as; infection, ulceration or destruction of tissues of the foot associated with neuropathy or peripheral artery disease in the lower extremity of a person with diabetes mellitus [3]. It is characterised by the classic triad of neuropathy, ischaemia and infection [4]. This is usually a chronic and late complication of DM, which is feared by the most patients and clinicians caring for them. For many, this condition causes a significant reduction in quality of life; with repeated hospital stays, disability and a profound socio-economic impact. It is estimated that the roughly half a billion people worldwide were living with DM in 2019 and this number is projected to increase by 25% in 2030 [5]. Out of the reported nearly 62 million diabetics in India alone, 25% develop diabetic foot ulcers resulting in around 100,000 associated leg amputations a year [6]. This only highlights the significant burden of this disease.

Progressive reduction in protective sensation to the lower limb

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and foot results from damage or dysfunction of the nerves (peripheral neuropathy) caused by DM. Consequently, the patients become less aware of minor trauma and the areas affected are subjected to repeated insult until ulceration and skin breakdown occurs. These wounds in turn can go unnoticed and become infected, further compounding the situation. Dysfunction of the motor innervation of the intrinsic muscles of the foot further leads to muscle and joint imbalances and progressive foot deformity (Charcot foot) with abnormal bony pressure points created increasing the risk of ulceration.

Ischaemia due to peripheral arterial disease (PAD) is the second most important aetiological factor in the development of diabetic foot ulcers [7]. PAD is the progressive occlusion lower extremity arteries due to atherosclerosis, and the presence of DM greatly increases the risk of PAD. Diabetes produces the pathological states of hyperglycaemia, dyslipidaemia and insulin resistance; which all play a role in the development and progression of atherosclerosis [8]. The occlusion of lower limb arteries eventually causes ischaemia and poor tissue healing, thus leading to the development of chronic non-healing lesions in the foot.

3. Significant types of DFD-neuropathic, ischaemic and sepsis

3.1. The neuropathic foot

Having an insensate foot (loss of protective sensation) as a result of diabetic neuropathy, in combination with abnormal loading of the foot due to deformity; creates pressure points or areas of high mechanical stress. This results in the formation of callosities (areas of hardened skin). Further point loading can lead to subcutaneous haemorrhage that progress to ulceration [9]. These ulcers are typically painless and tend to occur on plantar surfaces of the forefoot (around metatarsal heads), heel and over other areas that have increased contact pressures due to deformity or poorly fitting footwear.

3.2. The neuro-ischaemic foot

The PAD is often a co-morbidity associated with DM, which tends to worsen the severity and progression of PAD. This causes worsening obstruction to the peripheral arterial circulation-with vessels below the knee particularly affected [10]. Ischaemia often present as intermittent claudication and can progress to critical ischaemia, leading to compromised tissue perfusion and resulting in ulcerations which are poorly healing and eventually leading to the development of a non-healing ulcer. These are typically painless and tend to develop over the distal aspect of the foot, tips of toes where ischaemia is at its worst and gangrene can develop. Rarely, pure ischaemic ulcers may develop, but these are usually distinguished by being painful. The critically ischaemic foot requires discussion with the vascular surgery team, to know if the patient may benefit from revascularisation.

3.3. The septic diabetic foot

The worrying aspect of diabetic foot ulcers is their susceptibility to infection. In an insensate foot where the patient is not conducting regular self-care, hygiene and foot examination, an ulcer can remain undetected for some time until it becomes infected. This can range from a superficial infection (cellulitis) to one that penetrates deeper to involve the bone (osteomyelitis). Depending on the severity of the infection and the physiological state of the patient this can lead to sepsis. This is an emergent situation often requiring high dose intravenous antibiotics as well as surgical intervention for drainage, debridement and amputation (in severe

cases).

4. Traditional management of DFD

- (I) Poorly managed, diabetic foot can lead to prolonged morbidity, hospital stays foot amputation and death. This fulminant negative spiral involves; ulceration, infection, bony involvement sepsis and eventual amputation. The development of this downward spiral is usually multifactorial. To prevent and manage this situation it is therefore prudent to identify and address all patients related, and disease related factors that may be the contributing factors. This can make managing DFD quite complex. In normal times, to ensure positive outcomes for patients with diabetic foot disease; a multidisciplinary team (MDT) approach to management is adopted. This MDT approach has been accepted internationally and has become the cornerstone of management and prevention [11].
- (II) The 'prevention is better than cure' principle applies aptly in DFD education and prevention of its development (or at the very least the prevention of progression). Care for these patients usually involves prompt assessment (to identify the at-risk foot), pressure relief (using orthoses or close contact casts), wound care and surgical intervention for infection or ischaemia [9]. National guidelines in the United Kingdom (UK) have recommended the treatment of these patients by an MDT foot care service [12]. The collaboration between the different professionals that make up this service allows for a cohesive and high-quality approach to care.
- (III) It is important to note that challenges to delivering diabetic foot care have always existed. The difficulties in improving patient understanding and involvement as well as creating MDT services have been particularly evident in India and in other parts of the 'developing' world. Here, challenges are related to factors such as education level and literacy, cultural influences (e.g. no footwear indoors), socioeconomic status as well as ease of access to specialist care and facilities (e.g. in rural areas) [13]. These issues have been compounded by the COVID-19 pandemic worldwide, highlighting key areas of concern and putting many patients with DFD at potential risk.

5. Challenges of diabetic foot care during the COVID-19 crisis

Given the COVID-19 crisis, it has been difficult to maintain the high standards of care, for the DFD patients. The priority of the healthcare system in the midst of a pandemic has been focussed on slowing the spread of the virus and equipping healthcare facilities with the resources they need to deal with the wave of COVID-19 patients [14–17]. This has been through the reduction of footfall within hospitals by risk stratifying and rationalising clinical services as well as strict social distances measures in wider society and the protection/shielding of vulnerable groups. The implementation of these priorities along with other patient related factors have contributed to create a challenging situation in which to deliver diabetic foot care.

5.1. Protection of vulnerable patients and shielding principles

Since the early on in this outbreak there has been clear evidence to suggest that the elderly and those with significant co-morbidities tend to be at increased risk of poorer outcomes from COVID-19 infection. A meta-analysis from China found that DM was the third most prevalent cardiovascular/metabolic co-morbidity with

COVID-19. It was also found that the patients with DM or hypertension had a 2-fold increase in the risk of more severe disease and Intensive Care Unit (ICU) admission [18]. It is already well known that in general patients with DM are often at higher risk from a severe manifestation of viral respiratory illness e.g. H1N1 Influenza [19]. Therefore, it is not surprising that a significant proportion of patients in the vulnerable or shielded groups are those also suffer from DM and DFD. The need to protect these members of society from viral infection means that providing face-to-face care for patients with DFD is difficult.

5.2. Decreased capacity for clinics and hospital admissions

Globally, secondary care facilities have been pushed to reduce or cancel their routine services in order to mobilise staff to other high-pressure areas as well as reducing the numbers of patients attending hospitals unnecessarily. Normal running of outpatient clinics has stopped and in the large majority of cases these clinics are now triaged by senior clinicians and the patients risk stratified with only the most urgent cases being seen. Hospitals inpatient capacities have also been stretched by the high influx of COVID-19 patients; with fewer beds available for non COVID-19 patients. Similarly, in the primary setting; face to face appointments have been scaled down with telephone or virtual consultations preferred. This has raised the question of whether these alterations to services have been appropriate for those with serious non-COVID-19 conditions.

5.3. Staff shortages and staff related sickness amongst specialists

During this pandemic it has been extremely challenging to manage the man-power availability of healthcare staff. The advice around social distancing initially meant that if a healthcare worker or any member of their household showed any signs of infection then the whole household would have to self-isolate for 14 days. The much debated 'R number' or transmission rate of the disease also meant that infection in confined healthcare settings could spread rapidly. In some areas this caused mass staff sickness with key clinicians and specialist allied health professionals who make up the diabetic foot care teams, being unable to work.

5.4. Reduced allied health professional input

In order to best utilise resources, many allied healthcare professionals both in the community and hospital settings - including podiatrists, orthotics specialists as well as specialist nurses have been redeployed away from their normal duties to work in other high-pressure areas. These professionals usually play an important role in managing diabetic foot disease, often co-ordinating the patients' routine care and follow up in the community. The reduction in allied health professional input leaves a large gap in the provision of services where patients may potentially be left to fend for themselves.

5.5. Vascular services

Tertiary level vascular services have also been affected by this crisis. Now, many centres are not taking on any new referrals except for emergency cases. Satellite clinics and services in secondary care facilities are not being maintained and patients have to travel or transferred long distances to access care.

5.6. Transport difficulties

Where provisions have been made to see patients face to face;

finding a way to get to hospital has been a daunting prospect for many patients with DFD. Rationalisation of public transport services and the cutback on ambulance hospital transport has created a significant problem. It is important to remember that this patient cohort often have an element of limited mobility and may be fitted with offloading devices making it even more difficult for them to travel. In addition, many of them will be anxious about the risks of contracting Coronavirus, if they leave their homes to attend hospital appointments. For patients living in rural areas this is an even bigger problem as access to their nearest specialist centres may be severely limited as a result of travel restrictions [20].

5.7. Logistical difficulties

Day to day care for patients with DFD involves several logistical challenges. Patients need to have a way of accessing regular medications for their DM, as well as emergency prescriptions (e.g. antibiotics). They need to be able to access dressings for ulcers and wounds, offloading devices and orthoses, as well as ambulatory aids. This has been made even more difficult in the setting of lockdown and social distancing measures [20,21].

5.8. Patient related challenges

For the patients, the task of maintaining a healthy lifestyle during this pandemic has been easier said than done. 'Lockdown' measures have meant that these patients have lost their normal routine. Many patients who used to maintain a very active lifestyle as a method of helping control their DM can no longer access gyms, swimming pools and related facilities. In addition, large periods of time spent indoors can cause patients to fall into unhealthy eating habits. This combination of reduced physical activity, unhealthy diet and emotional stress can culminate in poor glycaemic control further increasing the risk of developing the DFD [22].

6. Solutions and currently adopted management principles for DFD during COVID-19

- (I) There has been significant variation to how different healthcare systems have handled the global outbreak of SARS-CoV-2. As part of that, there have been differences in the way diabetic foot disease management has been co-ordinated. In [Table 1](#) below we discuss some of the interventions that can be implemented to tackle the current dilemma of Diabetic foot care, and we debate their use and effectiveness.
- (II) **Patient Education & Self-care of Diabetic Foot Disease (DFD)**
 - (a) **Education:** It is crucial that the patients are counselled and reminded about managing their DM and maintaining good glycaemic control in spite of these difficult times. Any discussions had, or any resources provided to patients should contain information on diet, medications and exercise [23]. Patient education can be conducted at different points of care e.g. through an appointment with their primary care physician or via signposting to trusted online resources (an increasing common method in the digital age). For example, Diabetes Digital Media (DDM) is an online, scientifically based initiative who has launched a 'COVID-19 Education Series and Digital Classes Library' which has been released to 'support patients remotely'.

Unfortunately, poor patient awareness and lack of knowledge regarding diabetes complications and diabetic foot disease is well

Table 1
Interventions adopted with benefits to manage diabetic foot disease during COVID-19 pandemic.

Solution/intervention	Benefits
Patient education and the use of online resources	<ul style="list-style-type: none"> • Reminder to maintain glycaemic control through diet, exercise and correct medication. • Develop patient understanding of diabetic foot and risks of complications.
Encouragement of self-examination of feet and regular foot care	<ul style="list-style-type: none"> • Prevent the creation of pressure points around the foot and development of callosities. • Potential to detect and report signs of ulceration or infection early.
Telemedicine Consultations	<ul style="list-style-type: none"> • Allows triaging of patients and assessment of new referrals • Visualisation and evaluation of new or recently healed ulcers and assessment of the 'at risk' foot.

recognised [24]. However, what we also know is that there is clear evidence to suggest that patient education regarding foot-care and ulcer prevention can have profoundly positive effects in reducing ulcer recurrence, risks of amputation and overall morbidity [25]. So clearly, patient education is important and is proven to make a difference. The test here is identifying how to deliver key education principles in a format that all patient groups will be able to access.

- (b) **Self-care (Diabetes monitoring):** Regular routine monitoring of blood glucose levels at home is essential, particularly when patients may have diminished access to their regular check-up appointments. Provisions should be put in place to ensure patients are proficient in and comfortable in obtaining and recording accurate blood sugar levels. Patients should remain vigilant of hypo or hyperglycaemia episodes and how to address them.
- (c) **Self-care (Offloading and Regular Foot examination):** Patients must also understand and adhere to offloading precautions and must be willing and able to inspect skin and wounds regularly for signs of skin breakdown and suspected local infection. Where possible, it is recommended to offer removable casts and orthoses to facilitate self-examination and avoid hospital attendances for change of plaster casts [26].

The difficulty here is patient compliance. While in large part it is a positive step for patients to be given responsibility over their own health, for some patients this will be a burden they are unaccustomed to carrying. Often patients with diabetic foot disease become used to regular visits to their primary care physician or indeed interactions with their podiatrist and are happy to surrender their foot care to those professionals. With the onus now on patients to take on board advice and regularly look after their feet—a proactive attitude and engagement with the process is required to achieve positive outcomes.

(III) Remote monitoring—tele and video consultations

Telemedicine (TM) can be defined as the delivery of healthcare services from a distance through utilisation of telecommunication technologies [27,28]. Methods used include telephone consultations, video-call consultations as well as the use of photographs and instant messaging. Telemedicine revolution in India has helped in managing chronic conditions such as Diabetes and hypertension and monitoring diabetic retinopathy [29]. The Government of India telemedicine portal e-Sanjeevani is helping remote consultations reach countrywide [30]. The implementation of TM technologies has been shown to be both feasible and effective in preventing amputation in diabetic foot ulcers [31,32]. However, some concerns do exist regarding the validity of these methods and until now remote management of DFD has not been widely utilised [33].

To gain maximum benefit; TM consultations should provide the opportunity to:

- Educate patients
- Triage at risk patients, including those with recently healed ulcers
- Remotely assess and identify patients who require urgent attention (potential limb threatening pathology) and need to be offered face to face appointment

When used effectively a TM consultation will involve:

- Initial history taking and counselling: here the clinician is aiming to gather as much information as possible about the patient's condition and what steps have already been taken to manage it. With regards to counselling and education; this first and foremost needs to involve a general discussion on hygiene and COVID-19 prevention. Following on from that, the clinician can provide information on diabetes self-management and foot care as mentioned above [3].
- Foot examination and assessment can be facilitated through video visualisation or from pictures provided by the patient. Ideally assessment of any ulcer should take note of; Site of the lesion, Area, Depth and Signs of infection [12]. Other aspects of normal examination e.g., neuropathy and ischaemia may need to be ascertained through the initial careful history.
- Lastly, safety netting is crucial. Patients need to be provided with adequate information on who they can contact if their symptoms are deteriorating as often urgent intervention may be required.

There are several potential general barriers to providing a tele-medical diabetic foot service [34]:

- Lack of appropriate facilities/technological support: As TM is not yet used widely amongst most medical specialties; many healthcare settings are not appropriately equipped to provide this service; therefore, clinicians must work closely with the support teams within their organisation in an attempt to address this.
 - Limited access for some patient cohorts: factors such as age and socio-economic status may mean that certain patients could be unable to access or use information technology to facilitate remote consultations. In this instance we have a duty to provide patient centred care—patients with different circumstances should be afforded the support they require e.g. offering face to face appointments or home visits where feasible.
- (IV) Access to urgent care and advice

Patients and clinicians need to be vigilant with regards to high risk patients and the possibility of deterioration. Provisions must be in place to be able to direct patients to areas for urgent care be that through admission to hospital via Accident and Emergency department or through rapid access to foot care clinics. NHS

Table 2

Indications for various consultations for DFD patients.

Face-to-Face consultation	Remote consultations
Patient has active symptoms or signs of infection e.g. erythema, pain, swelling, discharge	New referrals with a foot considered 'at risk'
Patients with non-removable walkers that require removal by a professional to facilitate foot examination.	Patients with recently healed ulcers (<6 months) who require ongoing monitoring.
Patients with signs/symptoms suggestive of acute or progressive Vascular occlusion or development of ischaemic ulcers.	Stable patients with or without foot deformity who use removable offloading devices/orthoses.

England has released guidance regarding diabetic foot service management during this pandemic. It advocates the continuation of MDT diabetic foot services as they are deemed an 'essential service'. They recommend maintaining services both on an inpatient and outpatient basis and those clinicians should continue to see new patients; particularly those in the high-risk groups [26]. The International Working Group on Diabetic Foot (IWGDF) Guidelines for COVID-19 and DFD has also provided extensive guidance on how to approach diabetic foot management during this pandemic. While they advocate early triage and avoidance of hospital admissions where possible, they do clearly advise that any patients with high-risk lesions and potential limb threatening disease should be seen urgently face to face consultation with the specialists (Table 2) [3].

(V) Surgical Considerations

Patients requiring urgent surgical debridement can be divided into two groups; a) those that will benefit from revascularisation as well as debridement and b) those without significant vascular pathology that need debridement only. With the former group it is important to have good liaison with the regional vascular surgery teams and where feasible these patients should be transferred to facilities where these services are available. In the non-vascular but infected diabetic foot, it is prudent to consider offering surgery under Local Anaesthetic blocks. This will both avoid the risk of invasive intubation for a general anaesthetic as well as potentially allow for these procedures to be performed as day-cases to avoid prolonged admissions.

7. Conclusion

It is apparent that the COVID-19 pandemic has made the already complex management of DFD even more challenging, in these difficult times. Multi-disciplinary Diabetic foot care services have been put under pressure due to decreased hospital and clinic capacities, staff shortages and sickness, reduced allied health professional availability as well as other patient specific factors. The clinicians and carers looking after this patient group have had to adapt to the circumstances and use creative means to ensure their patients remain disease free and avoid hospital admissions. Patient education and promoting self-care is vital in the current environment. TM consultations have given clinicians the opportunity to manage their patients remotely and make triage decisions regarding who needs urgent face to face attention. Government of India e-Sanjeevani telemedicine portal development will go a long way to increase the availability of remote advice and monitoring for patients requiring care. Where surgical intervention is required, a preference should be given to the use of local anaesthetic or regional blocks to reduce the risks to patients and staff and allowing the patients to go home more quickly.

Funding statement

No funding was received for this article.

Declaration of competing interest

The authors do not mention any conflict of interest regarding this article.

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