
Impact Assessment of Diabetic Gangrene in Western Uganda

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1. Introduction

Diabetic gangrene is a chronic complication of diabetes which involves many medical, economic and social problems. It exerts a significant economic burden worldwide associated with high mortality (Hall et al., 2011) The surgical management of diabetic gangrene with limb salvage whenever possible accounts for huge expenditure in hospital practice, with long overall occupancy and considerable rehabilitation requirements (Vamos et al., 2010).

Historical background of this disease goes back to the 19th century and for much of the 20th century where it was conceptualized as 'gangrene in the diabetic foot' or as 'diabetic gangrene'(Connor, 2008). The prognostically and therapeutically important distinction between gangrene due to vascular insufficiency and gangrene due to infection in a limb with a normal or near normal blood supply was not made until about 1893(Connor, 2008).

Theoretically, diabetic gangrene is believed to most frequently affect digits of extremities. Gangrene of the lower limbs in diabetic patients and its malignant complication has been commonly reported (Gillitzer et al., 2004). Foot gangrene has also been reported to be 50 times more common in diabetic over the age of 40 than in non-diabetic of the same age (Gillitzer et al., 2004). Argawall et at. (2007) reported penile gangrene which may affect the prepuce and the glans penis. Fournier's gangrene is a rare, synergistic, fulminant form of necrotizing fasciitis involving the genital, perineal, and perianal regions (Eke, 2000). Fournier's gangrene is potentially fatal condition, affecting any age and gender, which results in thrombosis of small vessels,obliterated end arteries, and eventually skin and tissue necrosis (Yanar, 2006). Predisposing factors believed to contribute to the development of the disease are diabetes mellitus, alcoholism, malignancies, immunosuppression, liver, and renal disease (Kleemann et al., 2009).

The concept of the rising epidemic of diabetes mellitus and the observed increase of incidence of gangrene which has presented a substantial public health and socioeconomic burden in Sub-Saharan Africa has been widely reported (Mbanya et al., 2010). Diabetic neuropathy leads to a loss of sensation and subsequent alteration of the physical structure of the foot or any part of the body affected. The combination of tissue damage with increased susceptibility to infection in the foot leads to diabetic foot complications resulting in diabetic gangrene if not urgently managed. Interventions commonly employed in diabetic gangrene are limb salvage management and amputation which exert a lot of burden on the family and social institutions, that take care of this disability. Kidmas et al. (2004) in Nigeria reported 26.4% diabetic foot sepsis as one of the main indications for lower limb amputations. Agwu et al. (2010) reported 82% diabetic foot ulcers responsible for prolonged hospitalization of patients in South Southern Nigeria. Sié Essoh et al. (2009) reported 46.9% below knee diabetes related amputation and 11.2% below elbow diabetes-related amputations as common procedures performed in Ivory Coast (Cote D'Ivoire). However, in Zimbabwe, Sibanda et al. (2009) reported 9% diabetes related lower limb amputation rate among 100 patients evaluated

In the present context, Uganda has insufficient number of documented cases of diabetes care and even fewer data is available for diabetic gangrene among the diabetics. With increasing prevalence and interactions with other diseases, including the major communicable diseases in Uganda, diabetes is becoming a pressing public health problem.

1.1. Statement of the problem

Uganda is said to have 3.5% of its population as disabled (Monte, 2007) and extrapolated prevalence figure of 184,731 amputations annually (SCC, 2012). Unfortunately such data are lacking in highly systematic format that can give a picture of the contribution of diabetes gangrene to this number of amputations as in other developed countries. Economic cost of managing diabetes gangrene including limb salvage program, amputation and consequent disability is huge. If effective interventions are implemented in the near-future it may be possible to avert much of this burden, as primary prevention and treatment can reduce the incidence of both diabetic gangrene and a range of related diseases where diabetes is a causal factor. Information on the cost is lacking and yet critical for policymakers that can highlight the importance of introducing early and cost effective interventions for both primary and secondary preventions of diabetes gangrene.

1.2. The purpose of the study

The purpose of this study is to assess the impact of diabetes gangrene and its related complications among the diabetes in Western Uganda and the provision of relevant information for the planning of effective intervention for this disease.

2. Method

This was a retrospective evaluation of the impact of diabetes associated gangrene among patients in south western Uganda from May 2005 to July 2012. The seven years record of known

diabetic patients clinically diagnosed with gangrene attending clinic in south western Uganda were assessed to determine the impact of diabetes, on the overall prognosis, disease induction, progression, management- including cost, prevention and control. Hospital records of diabetic patients attending clinics at Fort portal regional and referral hospital made available for this assessment were those confirmed by laboratory investigation and clinical observation which fulfilled our data inclusion criteria.

Thirty eight patients has been considered as qualified for inclusion in this study over the seven years study period. Fort Portal regional and referral hospital in south western Uganda was selected to act as sentinel collection center because it is known to see over 60% of hospital attendees in this region. Pre-tested semi-structured data extraction tools were used to extract data from the records of patients in the selected hospital. Focus group discussion and interview of participants in the study and available hospital health care providers were used to collect information not provided by the available case files and hospital record. Seventy three Health care providers that included clinical officers, nursing officers, laboratory technologists, staff found in the hospital record departments needed in the data extraction tool were used for this purpose.

Ethical approval was sought for and obtained from Kampala International University Ethical review committee. Informed consent of those who were interviewed was obtained and actual participants were assured of confidentiality of the information they provided.

3. Results

3.1. Result from data extraction tool

The demographic data extracted from the files of 38 patients studied showed 51.4% were males and 48.6% were females with ages ranging from 20-100 with a mean age of 59 as shown in table 1

Age(years)	Male (%)	Female (%)
20-40	4(11.4)	3(8.6)
41-60	5(14.3)	7(20)
61-80	7(20)	3(8.6)
81-100	2(5.7)	4(11.4)
Total	18(51.4)	17(48.6)

Table 1. Sex distribution of studied population

Several symptoms associated with gangrene as reported by the attending clinician include but not limited to: fever, loss of appetite and tachycardia (Table 2). Five percent (5%) of the patients who reported at the hospital diagnosed of dry gangrene manifested with fever and loss of appetite. The causes of dry gangrene in 5.3% of the patients were trauma and diabetes while

2.6% was caused by hematological disorders. Of those diagnosed with wet gangrene, 36.8% had fever and 7.9% was associated with loss of appetite while 5.3% had tachycardia as seen in table 2. Only 2.6% patients attending clinics for medical checkup were diagnosed of gas gangrene with tachycardia primarily caused by hematological disorders

Types of Gangrene	Associated symptoms			Primary cause of gangrene			
	fever	LA*	Tachycardia	trauma	diabetes	malignancy	HD*
Dry gangrene	2 (5.3)	2 (5.3)		2 (5.3)	2 (5.3)		1 (2.6)
Wet gangrene	14(36.8)	3 (7.9)	2 (5.3)	4 (10.5)	14 (36.8)	1 (2.6)	1 (2.6)
Gas gangrene			1 (2.6)				1 (2.6)

Table 2. Primary cause of gangrene and associated symptoms

LA* loss of appetite, HD* hematological disorders

From table 3 below, 2.6% of the patients diagnosed of dry gangrene came to the hospital with complications of retinopathy and neuropathy. It was later found that 2.6% of patients were alcoholics and smokers. 13.2% of those diagnosed of wet gangrene came to the hospital with complication of retinopathy, 5.3 % came with neuropathy, cardiomyopathy, nephropathy respectively, and 42.1% of patients diagnosed of wet gangrene were old, 5.3% had malnutrition problem, 2.6% were smokers and alcoholics respectively. There was no reported case of gas gangrene or its complications and no identifiable risk factors associated with it.

Type of Gangrene	Associated Complications of Diabetes					Risk Factors			
	Retino-pathy	Neuro-pathy	Cardio-myopathy	Nephro-pathy	Mal-nutrition	Old Age	smoking	Alcoholism	others
Dry Gangrene	1(2.6)	1 (2.6)					1 (2.6)	1 (2.6)	1 (2.6)
Wet Gangrene	5 (13.2)	2 (5.3)	2 (5.3)	2 (5.3)	2 (5.3)	16 (42.1)	1 (2.6)	1 (2.6)	13 (34.2)

Table 3. Associated complications of diabetes and risk factors in relation to different types of gangrene

In table 4 below, 71.1% of the patients clinically diagnosed with wet gangrene received antibiotics, 68.4% were given analgesics, 55.3% were given intravenous fluids, and 26.3% were given general treatment in line with the clinical judgment of the attending physicians because the patients complained of complex clinical signs and symptoms. None were on hyperbaric oxygen treatment. 50% of patients diagnosed with wet gangrene were amputated while in 18.4% debridement has been performed. 18.4% of those diagnosed with dry gangrene were given analgesics and antibiotics, 10.5% received intravenous fluid therapy, while none received hyperbaric oxygen treatment. In the group diagnosed with dry gangrene, 13.2% were amputated while in 2.6% debridement was performed.

2.6% patients diagnosed with gas gangrene all received analgesics, antibiotics, intravenous fluid, hyperbaric oxygen treatment respectively. None of them received any surgical treatment.

Type of Gangrene	Medical Management					Surgical Management	
	Analgesics	Antibiotics	I V fluids	Hyperbaric oxygen	Others*	Debridement	Amputation
Dry gangrene	7 (18.4)	7 (18.4)	4 (10.5)		1 (2.6)	1 (2.6)	5 (13.2)
Wet gangrene	26 (68.4)	27 (71.1)	21 (55.3)		10 (26.3)	7 (18.4)	19 (50)
Gas gangrene	1 (2.6)	1 (2.6)	1 (2.6)	1 (2.6)	1 (2.6)		

Table 4. Management pattern for the different types of gangrene

*Others: general treatment in line with the clinical judgment of the attending physicians

To have an insight into the magnitude of the surgical management of gangrene and associated cost, a survey of the level of amputation was noted as shown in table 5. It was observed, that 13.2% of those diagnosed with wet gangrene, received foot amputation, 10.5% were amputated below and above the knee respectively, while 5.3% were amputated below the elbow, including 2.6% who received above the elbow amputation as surgical treatment. No case of gas gangrene received amputation as a solution to their issues.

Table 5 also shows that 68.4% of participants with wet gangrene and 15.2% with dry gangrene attended the public section of Fort Portal Regional and Referral Hospital, because they wanted free treatment (probably explained by the fact that they belong to the low income class, living on less than one dollar a day as suggested by Agwu (2011). On the other hand, 10.5% patients with dry, wet and gas gangrene who attended private wing of the hospital, were able to pay from fifty thousand Uganda shillings to two hundred thousand Uganda shillings or twenty to eighty United states dollars [50,000 to 200, 000 Uganda shillings or US\$20 to US\$80 dollars] as cost for both medical and surgical management of the gangrene simply because they belong to the high income class living on above US\$10 a day (Agwu, 2011)

Type of Gangrene	Level of Amputation					Cost (000 ug. /=)					Public
	Below Knee	Above Knee	Below Elbow	Above Elbow	Foot amputations	Others	<50	50-100	150-200	>200	
Dry Gangrene%		1 (2.6)	2 (5.3)		2 (5.3)					1(2.6)	6(15.2)
Wet gangrene %	7 (10.5)	4 (10.5)	2 (5.3)	1 (2.6)	5 (13.2)					2(5.3)	26(68.4)
Gas gangrene %								1(2.6)			

Table 5. Level of amputation and cost in different gangrenes

Type of Gangrene	Complications				Days on ward		
	Delirium	Circulatory cessation	Post surgical sepsis	others	1-7 days	8-14 days	>14 days
Dry gangrene		1(2.6)			3(7.9)	1(2.6)	3(7.9)
Wet gangrene	2 (5.3)		1(2.6)		10(26.3)	7(18.4)	12(31.6)
Gas gangrene					1(2.6)		

Table 6. Post surgical complications and duration on ward for the different types of gangrene

Postsurgical complications noted from the files were delirium, circulation cessation on the limb, and post-surgical sepsis as shown in the table 6. Two patients(5.3%) having wet gangrene had delirium after surgery, one patient(2.6%) with dry gangrene had circulation cessation on the limb while another patient(2.6%) came down with sepsis. Table 6 shows that 5.3% of diagnosed with wet gangrene had delirium, and in 2.6% post- surgical sepsis had taken place.

Again 2.6% of those diagnosed with dry gangrene had circulation cessation on the limb. Wet gangrene generally caused certain delay in treatment and longer duration of hospital stay compared to dry gangrene and gas gangrene, as seen on the table. 31.6% of wet gangrene and 7.9% of dry gangrene were recorded as days spent above fourteen days.

	Type of amputation					Outcome				
	Below Knee	Above Knee	Below Elbow	Above Elbow	Foot amputation	Others	Escaped	Discharge	Death	Referral
Dry Gangrene (%)		1 (2.6)	2 (5.3)		2 (5.3)			6(15.8)	1(2.6)	1(2.6)
Wet Gangrene (%)	7 (10.5)	4 (10.5)	2 (5.3)	1 (2.6)	5 (13.2)		2(5.3)	12(31.6)	10(26.3)	
Gas Gangrene (%)									1(2.6)	

Table 7. Types of amputation and outcome for the different types of Gangrene

From table 7 above, Patients who were diagnosed with dry gangrene had (15.8%) discharge, one (2.6%) death and one (2.6%) referral. Of those patients who came to the hospital and were diagnosed with wet gangrene, twelve were discharged after surgery (31.6%), while ten (26.3%) died and two patients refused surgery. One of the patients diagnosed with gas gangrene died after surgery.

3.2. Result from interview

It was not clear why only 38 cases of diabetic gangrene were recorded over a period of seven years in retrospect from 2005 to 2012. To clarify this observation in relation to the current situation we organized a throughout participants' interviews and focused group discussion with available health care workers. Majority of the respondents alluded to the fact of poor storage and retrieval of files which led to missing files of the patients, resulting in the management asking patients to go with their files.

During the interview most of the stake holders agreed that based on their experience in the hospital, in the diabetic clinic, laboratory investigations and clinical examinations, that wet and dry gangrene with diabetes were the most often diagnosed gangrene in this region of the country. When asked whether gangrene treatment responds faster in patients with diabetes than non-diabetic, most answered no and asked to compare response to treatment with other diseases like HIV, cancer and sickle cell disease base on their experiences their responses were negative.

4. Discussion

There was a high incidence of diabetes-related gangrene in the western region of Uganda as seen in this study especially in wet and dry gangrene types. Comparatively, 36.8% gangrene cases due to diabetes, was far more than the 10.5% due to trauma, and 2.6% due to malignancy and hematological disorders. This shows that diabetic gangrene is the most prevalent condition, that sends people to the clinic for medical attention. Several reviews have described the frequent occurrence of gangrene, infection and sepsis associated with diabetic disease (Abbas, 2007) and with trauma to the hand (tropical diabetic hand syndrome) (Abbas, 2002) in Sub-Saharan Africa

The rate of undiagnosed diabetes is high in most countries of sub-Saharan Africa, and individuals who are unaware of the disorder, are at very high risk of chronic complications. Therefore, the rate of diabetes-related morbidity and mortality in this region could grow substantially. The observed high mortality in patients with diabetes and high prevalence of diabetes complications is likely to be a consequence of many late diagnosed and poorly controlled cases (Hall et al., 2011). Assessing the public health importance of diabetes demands an appreciation of the impact of diabetes on other diseases and population mortality, and in particular the benefits of well-controlled diabetes for averting costly cardiovascular and microvascular complications (Kornum et al., 2008 and Holman, 2008)

It is known, that several abnormalities of the host defense system might result in a higher risk of certain infections, including gangrene caused by diabetes. These abnormalities include immunological impairments, such as impaired migration, intracellular killing, phagocytosis, and chemotaxis of polymorphonuclear leukocytes from diabetic patients and neuropathic complications, such as impaired bladder emptying. In addition, a higher glucose concentration in the urine may create a culture medium for pathogenic microorganisms.

In most African communities, delivery of diabetes care is integrated into the overall national health-care structure. The idea of a specialized diabetes care centers and teams is plausible, however limited funding renders it impossible (Whiting et al., 2003). Health-care systems in most African countries are state-funded and priority is given to the unfinished agenda of communicable diseases. In most countries, including Uganda, there's limited free National Health Service; therefore, some patients may be treated free in the public unit of the facility while the private patients may enjoy some additional services. This was the case in Fort Portal regional and referral hospital where most of the diabetes related gangrene was treated in the public unit of the hospital free. In some cases the public unit may lack drugs and other facilities and when an individual with diabetes cannot afford the cost of drugs, the situation could be fatal (Beran and Yudkin, 2006). Several important challenges to accessing diagnosis and treatment have been identified in literature: the high financial cost of treatment, particularly that of insulin; the limited availability of diagnostic tools, treatment and glucose monitoring equipment; and a low awareness of diabetes among healthcare professionals (Beran et al., 2005). The total cost of these complications is likely to far outweigh the cost of effective primary and secondary prevention which is recommendable at this stage

In a region, where diabetes prevalence will double within the next 20 years, creation of a community-based system with appropriate financing should allow for cost-effective and rational use of limited resources. Meanwhile, in most rural and some urban African settings, health beliefs, knowledge, lay views, and health behaviour interact strongly (Kiawi et al., 2006, Awah et al., 2007). Due to misconceptions, indicated by popular health beliefs, many people in Africa fail to take proper measures for prevention and control of diabetes and its risk factors (Kiawi et al., 2006). Obesity is still seen as a sign of good living, because it confers respect and influence. Such lay perceptions are borne out of a contextual environment, in which most people are poor, hungry, and disadvantaged and, therefore, see obesity as a clear social marker for wealth (Renzaho, 2004). Persistent poverty and lack in much of sub-Saharan Africa means that traditional perceptions and cognitive imagery about lifestyle risk factors of diabetes are unlikely to alter in any important way, unless socio-culturally appropriate health promotion campaigns are implemented.

Gangrene has been a challenging public health issue for decades and continue to complicate already complex public health problems in developing and underdeveloped countries, including Uganda. The problem of case file storage and information retrieval as observed in this hospital opened our eyes to new area of challenge that could complicate effective management of gangrene in developing and underdeveloped countries. Other challenging factors include:

1. limited resource to assist in prompt diagnosis and treatment,

2. poorly organized health systems, manned by low skilled healthcare providers,
3. poor up-take of health services by local dwellers, orchestrated by tradition, believes and demotivation due to low per capita income.

Poor information storage and retrieval can be explained by the facts that patients are still allowed to go home with their case files and to come back with them when next they need to see a health care provider. The authorities of the sentinel centers surveyed confirmed that such policy was practiced because there is poor attraction and retention of health workers at the rural communities thereby impacting on the capacity of the hospitals to maintain a system that would have accounted for all health issues in the hospital. This makes it difficult to control cases of dropouts where some patients who went home with their files never came back either because they are dead or moved to another location.

5. Conclusions

Diabetes gangrene has contributed to the high incidence of diabetes-related disability, morbidity and mortality in Uganda. The observed high mortality in patients with diabetes and high prevalence of diabetes complications is likely to be a consequence of many late diagnosed and poorly controlled cases. Hall et al. (2011) observed, that whilst epidemiological studies outside Sub-Saharan Africa have associated diabetes with infectious diseases of great importance in this region, the literature review identified little epidemiological data of this association in Sub-Saharan African countries like Uganda. This problem could have been contributed by poor information storage system identified in this study. Low skilled personnel who are demotivated due to low wages could not offer any new ideas on how to move the health system forward. Instead of being agents of change to optimize uptake of health services to the local communities, we found, that they themselves are victims of such factors as tradition, religious beliefs and demotivation among other factors which are known to dissuade people from utilizing the few available services in the communities. There is therefore a big gap between the available health care providers and locals who are supposed to reach out for the local communities.

Recommendations

Skill acquisition training workshops and health promotion to debunk erroneous ideas and beliefs surrounding diabetes gangrene are highly needed in Uganda. Anthropological perspectives are needed to elucidate the causes, prevention and control of diabetes, especially in Uganda as other African counties, where health outcomes are highly dependent on cultural variables. This in-depth qualitative research will inform stakeholders of the need for development and delivery of programs to prevent and treat diabetes and other chronic diseases, and will complement findings of quantitative epidemiological research. Multifaceted multi-

disciplinary research is also vital to clarify root causes and trends in the epidemiological transition of increasing diabetes in Africa

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