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Study of Micro Organisms in Diabetic Foot and its Management

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Abstract

Background and Aim: Diabetic foot ulcers (DFUs) and diabetic foot infections (DFIs) are associated with reduced patient quality of life, lower-extremity amputation, hospitalization, and high morbidity and mortality. Diverse bacterial communities have been identified in DFUs, playing a significant role in infection prognosis. Hence this review done to evaluate the current state of play in etiology of DFUs by culture methods to Improve prognosis and reduce burden of diabetic foot in form of decreasing hospital stay and health cost.

Materials and Methods: A retrospective analysis was done for the patients with diabetic foot ulcer. A total of 292 samples were included in the study among which 160 male and 132 female, attending the surgery department outpatient and indoor were included. Institutional ethical clearance was taken and informed consent was obtained from the subjects in their own language.

Results: 310 samples were collected from patients with diabetic foot ulcers. From these samples, 292 having positive cultures. Overall, 91 culture results (31.18 per cent) were gram-positive, 149 culture results (51.02 per cent) were gram-negative and 52 culture results (17.80 percent) were poly-microbial.

Conclusion: Proper tissue sampling, advanced culture and sensitivity methods for diagnosis, targeted antibiotics, surgical procedures, and sugar control with regular medications can prevent infection progression and more importantly, the risk of lower extremity amputation.

Keywords: Diabetic foot ulcers; Diabetic foot infections; microbiology; culture; prognosis.

Introduction

The number of people with diabetes is expected to increase rapidly—from 450 million in 2020 to a predicted value of 600 million by 2030. More than one-third of people with diabetes develop diabetic foot ulcers (DFUs) during their lifetime, with half of these becoming infected and causing diabetic foot infections (DFIs). Fifteen percent of patients with DFIs require lower limb amputation to prevent progression of the infection.[1]

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Diabetic foot care is very expensive, with an estimated INR 1.5 to 2 lakh annual cost per patient, thus emphasizing the importance of early diagnosis and treatment of DFUs/DFIs.[2] Treatment consists of improving patient intrinsic factors, such as improving glucose control, as well as targeting extrinsic factors, the principal being the removal of bacterial contamination/infection. However, DFUs/DFIs harbor diverse bacterial communities, which increase the difficulty in treatment choice.

There are several laboratory techniques available with different sensitivities and specificities to determine the bacterial composition of DFUs/DFIS. Nonetheless, the characterization of the entire polymicrobial community at different severity stages ranging from mild to severe is still a major challenge.[3] Although culture-based methods are the principal method of bacterial identification, they often produce false-negative results in patients who have received antibiotics; fail to identify slow-growing, fastidious, anaerobic, and unknown pathogens; and are time-consuming, hindering proper and early detection of the bacterial community in DFUs/DFIS. Recent advances in molecular technologies overcome many of the mentioned inadequacies and provide new insights into the bacterial diversity of DFUs/DFIS.

This review done to evaluate the current state of play in etiology of DFUs by culture methods to Improve prognosis.

The first and most critical step, not only in culture-based methods but also in advanced molecular-based approaches, is sample collection. Historically, curettage, biopsies, swabs, and wound aspirations have been the principal routine samples taken by wound care providers.[4] As the Infection Disease Society of America (IDSA) advises that samples be taken from the base of wounds, tissue biopsies have been proposed as a gold standard method.[5] Swabcultures of the wound surface are also commonly used, but due to a high number of commensal microflora inhabiting healthy skin, swab culture results may not be as reliable as tissue samples.[6] For instance, coagulase-negative staphylococci (CoNS), Micrococcus, Bacillus spp., and Corynebacterium, which are a part of normal skin flora and have been frequently isolated from DFIs swabs, are not usually considered as pathogenic bacteria, unless the samples are taken from deep tissues.[7] Even though the collection of swab samples is easier than tissue samples, some studies have shown that swab culture results are less specific and sensitive.[8]

Swab samples are less reliable in isolating Gram-negative bacteria such as E. coli and Citrobacter. Moreover, some Gram-negative bacteria, such as Ralstonia pickettii and Serratia, were only identified in deep tissue sample.[8]

Deep tissue samples also showed higher sensitivity for the monitoring of bacterial species that have been previously reported as antibiotic-resistant strains.[7]

Based on the aforementioned studies that compared the efficiency of bacterial culture using tissue and swab samples, it can be stated that tissue samples provide more reliable results for bacterial identification and monitoring of bacterial population in DFIs.

Materials and Method

This retrospective study was conducted at the Department of Surgery, in the medical college and associated hospital. 292 samples from diabetic foot ulcer among which 160 male and 132 female, attending the surgery department outpatient and indoor were included . Informed consent was obtained from the subjects in their own language.

All patients having diabetic foot ulcers where ulcer duration is greater than three weeks were included in the study.These patients had received antibiotics earlier.

The patients were assessed through detailed history and clinical examination. Surgeons assessed the ulcers, and after debridement material for culture was collected with a cotton-tipped sterile swab from the deeper parts of the foot ulcer.

We have devided ulcers in 3 grades.

Table no. 1 Grading of Wound

GRADE I (MILD)	Localised, superficial ulcer	134
GRADE II (MODERATE)	Deep ulcer to bone, ligament and joint	112
GRADE III (SEVERE)	Deep abscess, gangrene of toes, forefoot and foot	46

Results

A total of 292 patients who meet the inclusion criteria were included in the study. The study was conducted over the duration of one year. The included patient's age ranged from 35 years to 80 years. Maximum numbers of patients were in the age group of 50 to 60 years. Minimum numbers of patients were in age under 45 years. Out of the total 292 patients there were 132 females and 160 males. The complete history was recorded.

WOUND GRADE	Total	(Mono vs Poly microbial)
GRADE I (MILD)	134	132 + 02
GRADE II (MODERATE)	112	104 + 08
GRADE III (SEVERE)	46	04 + 42

Overall, 91 culture results (31.18 per cent) were gram-positive, 149 culture results (51.02 per cent) were gram-negative and 52 culture results (17.80 percent) were poly-microbial.Staphylococcus aureus and Escherichia coli were the most commonly isolated organisms (24.1 and 20.8 per cent respectively) followed by Pseudomonas aeruginosa (18.1 per cent), Citrobacter sp. (12.1 per cent), Klebsiella oxytoca (11.1 per cent), and Proteus sp. (9.8 per cent). Other uncommon bacterial species (3-4 percent) were also isolated.

Out of 134 patients with Grade I ulcer, 132 were mono microbial and 2 having poly microbial; from 112 grade II, 104 isolates were mono as compared to 8 poly microbial, and 46 Grade III comprises of 04 mono microbial and 42 poly microbial isolates.

Table no. 2 Mono microbial vs Poly microbial

Out of 292 patients 26 patients having newly diagnosed diabetes mellitus, 22 patients were off treatment and 46 patients reported with irregularity in taking OHA. Majority of patients having history of trauma or itching at site of ulcer. Out of 22 patients who are off treatment; 15 patients fall in to grade II category, out of which 04 patients ends in to grade III. Out of 46 patients who are off treatment; 26 patients fall in to grade II category, out of which 2 patients ends in to grade III category.

Table no. 3 Treatment Protocol

WOUND GRADE	Treatment Protocol
GRADE I (MILD)	Dressing, Oral and targeted Antibiotics
GRADE II (MODERATE)	Dressing & Broad spectrum parenteral Antibiotics
GRADE III (SEVERE)	Broad spectrum antibiotics + daily dressing + Amputation

Discussion

292 samples were collected from patients with diabetic foot ulcers.Overall, 91 culture results (31.18 per cent) were gram-positive, These resultsare relatively similar to the number of Gram-positive bacteria in Al Benwan's study (32.3% of isolates)[9], which applied culturomic methods to isolatebacterial species, which wasquitelowcomparedtothenumber ofGram-positive species in Jneid's study (54.7% of isolates). 149 culture results (51.02 per cent) were gram-negative, which wasquitehighcomparedtothe numberofGram-negativespeciesinJneid'sstudy(26.4 %ofisolates)[10]. and 52 culture results (17.80 percent) were polymicrobial which was relatively lower compared to Sánchez's study[11] (48.3%); which was opposite to Citron's study[12]with 83.8% of positive cultures were polymicrobial with a mixed population of Gram-positive and Gram-negative species.

As noted; with increasing grade of the wound significant increase in number of poly-microbial isolates found.

Although culture-based methods have been the gold standard for bacterial identification for many years, this approach may not necessarily reflect all

the clinically important pathogenic bacteria in DFIs, particularly anaerobes and uncommon species. The study of slow-growing, fastidious, anaerobic, and unknown pathogens, which normally have been underestimated by culture-based methods will provide an early warning system necessary for modification and alteration of antibiotic therapy.

Conclusions

There have been many studies on the bacteriology of DFUs/DFIs over the past decades with varying, and sometimes inconsistent results. These discrepancies might be due to demographical and geographical differences, various processes of sampling, human errors, sample size, and different bacterial identification methods used.

While antibiotic treatment for DFIs is initially prescribed empirically, accurate bacterial identification of DFIs can improve therapeutic approaches. The selection of the most effective antibiotic is a vital step to reduce the treatment period, prevent the expansion of resistant bacterial strains, and limit health costs.[13]

It may be concluded that from clinician side; proper tissue sampling and advanced culture and sensitivity methods should be used so that one can givetargeted antibiotics according to sensitivity and promote healing of wound; which can also be improved by proper surgical debridement and dressing techniques.

And With patients role in effective foot care, anti-diabetic diet, adequate sugar control and regular anti diabetic medication can reduce burden of diabetic foot in form of decreasing hospital stay and health cost.

Ethical Clearance: Taken from IRB

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Placental Laterality as a Predictor for Development of Preeclampsia

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Abstract

Background: Preeclampsia is a pregnancy-related condition characterized by high blood pressure and proteinuria after 20 weeks of pregnancy. It's a multiorgan disorder with no recognized cause. It's one of the most prevalent pregnancy problems, and it's a leading cause of maternal and foetal mortality and morbidity

Objectives: To determine the placental laterality as a predictor for development of pre-eclampsia.

Methods: 100 pregnant women with gestational age between 18 to 24 weeks with h/o pre-eclampsia were included. ultrasonography was used to determine the position of the placenta in all 100 women. When the placenta was evenly divided across the right and left sides of the uterus, regardless of anterior, posterior, or fundal location, it was categorized as central.

Results: The mean age group was 23.53 ± 3.15 yrs. The prevalence of pre-eclampsia in this study was 14%. This screening test has Sensitivity of 81%, Specificity of 85.3%, Positive predictive value of 47.2%, Negative predictive value of 96.43%, p value <0.001 which is significant.

Conclusion: Placental laterality is an excellent screening tool for the prediction of pre-eclampsia aids in the identification of the individuals particularly at risk, allowing them to be included in a primary prevention programmes.

Keywords: Placenta, Pre-eclampsia, Unilateral placenta, Central placenta

Introduction

Preeclampsia is a pregnancy-related condition characterized by high blood pressure and proteinuria after 20 weeks of pregnancy.[1] It's a multiorgan disorder with no recognized cause.[2] It's one of the most prevalent pregnancy problems, and it's a leading cause of maternal and foetal mortality and morbidity.[3] It is the 2nd significant cause of maternal mortality and morbidity in underdeveloped nations, complicating 7-10% of all pregnancies.[4]

In patients with hypertension with a normal heart, cardiac failure with pulmonary edoema can develop. Pregnant women, especially those who are pre-eclamptic, are more likely than non-pregnant

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women to suffer pulmonary edoema. Preeclampsia is also known to be a risk factor for peripartum cardiomyopathy and subsequent cardiovascular disease.[5]

Only the presence of a placenta causes preeclampsia. Abnormal wave patterns suggesting inadequate uterine perfusion are largely a result of placental implantation when one uterine artery is the primary source of the intervillous flow, according to noninvasive doppler velocimetric examinations of the uterine arteries in the second trimester.[6]

In the majority of individuals with aberrant flow velocity waveforms, the placenta is positioned laterally. In light of these findings, we devised prospective research to observe if the lateral placement of the placenta as detected by ultrasound at 18-24 weeks of pregnancy may be used to predict preeclampsia.[7]

To be effective, a screening test must be accurate, inexpensive, and easy to administer. It should improve the prediction value, and preventative actions should be effective. Good prenatal care, followed by appropriate treatment, will undoubtedly aid the mother and the baby in achieving a positive outcome.

Materials and Methods

Study design: Random prospective observational study

Study Setting: Department of Obstetrics and Gynaecology, Shadan Institute of Medical Sciences and Research Centre

Study Duration: 14 February 2022 to 30 August 2021

Study population and Size: 100 Pregnant women attending the Obstetrics and gynecology department.

Inclusion Criteria:

- Patients with gestational age between 18 to 24 weeks.

Exclusion Criteria:

- h/o chronic hypertension, Diabetes Mellitus, Renal disease
- BP >140/90 mm Hg
- Evidence of proteinuria

Pregnant women with Rh Negative, past h/o pre-eclampsia, and family members with h/o pre-eclampsia were also included in the research.

At 18-24 weeks, ultrasonography was used to determine the position of the placenta in all 100 women. When the placenta was evenly divided across the right and left sides of the uterus, regardless of anterior, posterior, or fundal location, it was categorized as central.

It was defined as unilateral right or left placenta when 75 % or more of the placental mass was on one side of the midline. The study's end point was either the onset of hypertension according to ACOG guidelines or the delivery.

Routine prenatal appointments were followed up on for signs and symptoms of pre-eclampsia, including blood pressure, serial weight, edoema, and pre-eclampsia investigations where necessary, with the results recorded. The mode of delivery as well as the foetal fate were documented.

Statistical Analysis: The SPSS 22 software was used for statistical analysis. The data was presented in the form of means and percentages.

Observation and Results

Table 1: Distribution based on Age group

Age in years	Frequency	Percentage
≤ 20	20	20%
21-25	52	52%
26-30	20	20%
>31	8	8%
Total	100	100%
Mean ± SD	23.53 ± 3.15 yrs	

The majority of the patients belonged to the age group of 21 to 25 yrs with incidence of 52%, followed by <20 yrs and 26 to 30 yrs age group in 20% of the cases each, least belonged to the age group of >31yrs with 8% cases. The mean age group was 23.53 ± 3.15 yrs.

The association between maternal age and the

incidence of pre-eclampsia demonstrates that young primigravida have a greater incidence than older primigravida. Preeclampsia was common in the research group between the ages of 20 and 25, and it was prevalent above the age of 30.

High incidence of pre-eclampsia in primigravida (81%) than in multigravida (19%)

Table 2: Distribution of patients according to severity of pre-eclampsia in study and control group

Type of pre-eclampsia	Study group	Percentage
Mild Pre-eclampsia	13	92.85%
Severe Pre-eclampsia	1	7.14%
Total	14	
Eclampsia according to Risk		
Low risk	9	64%
High risk	5	26%

According to the severity of pre-eclampsia, In the study group, 13 patients had mild preeclampsia and 1 patient had severe preeclampsia.

Out of 14 patients with preeclampsia, 64% pre-eclampsia was seen in low risk patients and 26% pre-eclampsia was seen in high risk patients.

Table 3: Relationship of placental position and development of pre-eclampsia in high and low risk women

Placental Position	Developed pre-eclampsia	Normotensive
Central (n=76)	3(21.42%)	73(84.88%)
Lateral (n=24)	11(78.57%)	13(15.11%)
Placental Position in high risk		
Central (n=18)	1(20%)	17(94.44%)
Lateral (n=5)	4(80%)	1(5.55%)
Placental Position in low risk		
Central (n=58)	2(22.22%)	56(82.35%)
Lateral (n=19)	7(77.77%)	12(17.64%)

Around 11 patients in the lateral placenta group developed pre-eclampsia which accounted for 78.57% of all pre-eclamptics. 4(80%) patients in the lateral placenta group developed pre-eclampsia in the high risk group. 5(77.77%) patients in the lateral placenta group developed pre-eclampsia in the low risk group. p-value is <0.001 and is highly significant. Most patients developed pre-eclampsia between gestational age of 36 to 40 weeks indicating that the incidence is higher in later part of gestation

Table 4: Distribution based on sensitivity and specificity

Statistic	Value
Sensitivity	81%
Specificity	85%
Positive Likelihood Ratio	5.4
Negative Likelihood Ratio	0.223
Positive Predictive Value (*)	47.2%
Negative Predictive Value (*)	96.43%
Accuracy (*)	81.27%

This screening test has Sensitivity of 81%, Specificity of 85.3%, Positive predictive value of 47.2%, Negative predictive value of 96.43%, p value <0.001 which is significant.

Discussion

Preeclampsia is a multi-organ systemic clinical condition that continues to be the leading cause of maternal and neonatal mortality and morbidity. The quest for the perfect prediction test and preventative strategy continues to be arduous.

Unfortunately, compared to advancements achieved in eradicating other catastrophic medical conditions, there has been little success in predicting this disorder. The scope of the problem, as well as the repercussions for the mother and the newborn, must be highlighted and updated, particularly in developing nations where the occurrences are high. The enormous expense of critical care for the mother, the infant, and the long-term complications in the preterm or intrauterine growth restricted baby will tend to have an impact on health systems unless effective preventative strategies are developed and implemented. The quest for the optimum prediction test and preventative measures continues to be arduous. Regardless of whether the placenta is laterally placed, the majority of the time, one of the uterine arteries meets the uteroplacental blood

flow demands, with some help from the other uterine artery via collateral circulation. The degree of collateral circulation may not be the same in all women, and a lack of contribution may render preeclampsia, IUGR, or both quite probable.[8] Normal placentation is critical for cytotrophoblastic invasion, because cytotrophoblasts in preeclampsia do not develop a vascular adhesion phenotype. When the uteroplacental blood flow demands are mostly satisfied by one side uterine artery, this might explain why trophoblastic invasion is minimized in laterally located placentas.

The prevalence of pre-eclampsia in this study was 14% which is similar to previous studies with 14%,[9] and another study with 13.6% prevalence of pre-eclampsia.[10]

This study result concurs with Kofinas et al., who observed that women with a unilateral placenta had a 2.8-fold higher risk of preeclampsia than those with a centrally located placenta.[11] The current study's findings were also comparable to those of Kalanithi et al., who reported that the development of PIH and IUGR pregnancies was about fourfold higher in lateral placentation.[12]

Females with a laterally placed placenta are five times more likely to develop PIH, therefore these pregnancies may require circumspect obstetric management to obtain a better outcome and minimize preeclampsia-related maternal and neonatal illness and mortality.

Conclusion

The study concludes that, among several screening tests, placental position assessed by ultrasonogram between 18 and 24 weeks of pregnancy is a good screening technique for the prediction of pre-eclampsia since it is simple and easy to conduct, inexpensive, and included in the anomalies scan. The procedure is painless and convenient for the patient.

Lateral placentation aids in the identification of the individuals particularly at risk, allowing them to be included in a primary prevention programmes.

Ethical Clearance: Ethical clearance was obtained from the Institutional ethical Committee.

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