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The impact of using the term “Diabetic Ear” for the patients with Skull Base Osteomyelitis

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Abstract:

BACKGROUND: Diabetes and ear disease are some of the most widespread health concerns. The focus here is on the impact of using the term “Diabetic Ear” for patients with skull base osteomyelitis (SBM) in the context of malignant otitis externa (MOE). The aim of this study was to discover the awareness of general practitioners (GPs), residents, specialists, and consultants at Primary Health Care Centers about necrotizing otitis externa (NOE), also known previously as malignant external otitis (MOE), assess their deficiencies and provide solutions; also assist them for the early detection and possible prevention of diabetes-related ear diseases and their complications.

MATERIALS AND METHODS: A cross-sectional study was conducted among a random sample of physicians (residents, specialists, and consultants) working at the Primary Health Care Centers in Al-Khobar and Dammam cities of the Eastern Province, Saudi Arabia. Data was collected using a standardized questionnaire. SPSS was used for data entry and analysis.

RESULTS: The total number of medical practitioners was 84. Their mean age was 33.97 (± 9.55). The proportion of females was higher than males, only 28.3% of the participants responded correctly when asked about MOE. Similarly, very few were aware of the risks of MOE (2.5%), complications associated with it (17.3%) and the necessary procedures for managing patients (24.2%). The awareness of doctors in the primary health clinics about MOE was significantly better than those in hospitals ($P = 0.002$).

CONCLUSION: There was a significant deficiency in the knowledge of GPs on MOE. Therefore, health education and awareness programs on MOE are recommended. Furthermore, we recommend that it is necessary to encourage the use of the term “Diabetic EAR” to increase the level of awareness of physicians about MOE.

Keywords:

Diabetes mellitus, malignant otitis externa, skull base osteomyelitis

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Introduction

Malignant otitis externa (MOE) is an aggressive virulent infection of the external auditory canal and skull base, which ultimately involves intracranial structures. This condition is caused uniformly by *Pseudomonas aeruginosa* that primarily affects the elderly and diabetic patients.^[1,2] The overall prevalence of diabetes mellitus in the adult population of Saudi Arabia is 23.7%.^[3,4]

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A new study revealed poor knowledge of the risk factors of Diabetes Mellitus type 2 and the preventive measures for Saudi patients in the Eastern Region.^[5] Recent reviews have reported the prevalence of diabetes MOE cases as 90%–100%.^[6,7]

The effective treatment of MOE requires an early diagnosis which demands a high index of suspicion, especially at the early stages of the disease, which is identical to the classic otitis externa.

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Failure to accurately diagnose MOE may lead to prolonged patient suffering.^[8] Therefore, the proper education of healthcare providers on this condition is crucial in ensuring that diabetic patients are properly counseled with regard to diabetic ear diseases and their complications.

The role of family physicians who provide primary medical care is of great importance. They should always keep in view the possibility of necrotizing otitis externa when patients complain of otalgia, particularly if they have diabetes mellitus and otitis externa that is resistant to standard methods of treatment.^[9]

To the best of our knowledge, there are no data in Saudi Arabia on the awareness of the risk factors and preventative measures for MOE in diabetic patients. Therefore, this study was designed to evaluate the awareness of general practitioners (GPs) regarding diabetic ear disease, particularly the early diagnosis of MOE to avoid suboptimal treatment and inadequate follow-up that inevitably lead to unnecessary disabilities and complications. This information would promote the use of the international term “DIABETIC EAR” and national preventive programs to prevent MOE in diabetic patients. It would also address the shortcomings in the knowledge of GPs and help to improve the weak areas identified in this survey.

Materials and Methods

A cross-sectional study was conducted about MOE in Al-Khobar and Dammam cities of the Eastern Province, Saudi Arabia, at primary health care centers. A close-ended questionnaire comprising a total of 15 multiple-choice questions was designed to cover four different dimensions important for assessing physicians’ knowledge, i.e., the causes, diagnosis, management, and complications of MOE.

The total population was 236 doctors. The sample consisted of 84 GPs of primary health care centers; (residents, specialists, and consultants) 35% of the total population in Al-Khobar and Dammam cities of the Eastern Province, Saudi Arabia, managing malignant external otitis disease on diabetic patients.

Before the final form of the questionnaire was settled, a pilot study was designed to test its validity with a sample of 20 GPs, residents, specialists, and consultants working on MOE in hospitals and primary health care centers.

A reliability test was conducted on 20 questionnaires to measure the internal consistency of the study instrument. The researcher investigated this by finding correlation coefficients using the Pearson correlation coefficient,

which indicates the reliability of the questionnaire and its ability to measure what it was constructed for. All values of correlation coefficients of questionnaire were positive and statistically significant at 0.05 level [Table 1]. To ensure the reliability of the questionnaire, we used Cronbach’ alpha to measure coefficient of stability and the Pearson correlation coefficient to measure internal consistency.

The alpha coefficients for the constructs ranged from 0.70 to 0.88. The results of the reliability test for the constructs confirmed that all measures in this study were reliable.

Participants were asked questions about their knowledge, awareness, and capability to diagnose and manage MOE. The questionnaire began with an assessment of their awareness and management of otitis externa in general. The remaining questions evaluated their general knowledge of MOE. The responses to the questions reflected the physicians’ awareness of the risk factors and complications of MOE and the ability to diagnose otitis externa and how to manage MOE. Study participants were selected using simple random sampling method.

The study was conducted after permission was granted by the Institutional Ethics Committee (Institutional Board Review). Both verbal and written consent were obtained from the doctors. Written permission was obtained from the respondents before participation in the study. The study data were used for research purposes only. The privacy issues will be respected. The data were statistically analyzed using SPSS, version 22 statistical program (SPSS Inc., Chicago, IL, USA) was used for descriptive and analytical statistics, the significance was considered when the *P* value was less than 0.05 ($P < 0.05$). The figures were prepared using Microsoft Excel (Microsoft Office 2010, Redmond, WA, USA).

The following statistics were then calculated:

- Cronbach’s alpha to test the reliability of the questionnaire
- Pearson correlation coefficient to measure the internal consistency of the questionnaire
- Frequency, percentage, to identify the sociodemographic variables of participants
- Frequency, percentage, and arithmetic mean to identify the responses of GPs (residents, specialist, and consultant), general knowledge, and physicians’ awareness and management
- The standard deviation of the order of the statements in favor of the least dispersion when equal to the arithmetic mean
- Chi-square test, to test the relationship between socio-demographic variables and knowledge and awareness, also relation to measures practiced levels
- To find the correlation between knowledge and awareness, Pearson correlation coefficient was used.

Table 1: Pearson correlation coefficients between each question of the questionnaire and the total (n=20)

Questions	Pearson correlation coefficient	p-Value
Do you see patients with otitis externa?	0.382	0.037
If yes how would you manage such condition?		
Do you have any difficulty in examining a patient's ear?	0.501	0.005
If yes what is the reason of such difficulties?		
What types of otitis externa do you know?	0.318	0.037
Are diabetic patients more risk of getting otitis externa than normal people?	0.399	0.029
If yes, how do they present?		
Are diabetic patients more prone to getting a severe form of otitis externa than normal patients?	0.378	0.032
From your opinion, what do you think is the cause?		
If you have a Diabetic patient with severe earache, minimal discharge and on examination there is granulation deep within the external auditory canal, Your differential diagnosis	0.578	0.003
If you took an ear swab from diabetic patient with otitis externa for culture what's the most common organism that you will get?	0.530	0.004
From your opinion, what is the common complications that occurring in a diabetic patient with sever otitis externa?	0.488	0.014
What do you think is the proper management to treat diabetic patient with sever otitis externa to prevent complications?	0.590	0.002
If you would like to investigate diabetic patient with sever otitis externa which of the following laboratory test you would order in addition to the general investigations?	0.489	0.014
How would you confirm the diagnosis of this severe otitis externa in a diabetic patient Radiologically?	0.588	0.003
If you diagnosed patient as having an otitis externa, When you usually refer him to an otolaryngologist?	0.367	0.030

Results

Participants were asked about their practice setting, whether hospital or primary health care; the majority were working in the primary clinics 55 (71.4%) and the rest 22 (28.6%) were hospital staff [Figure 1], only 7 of participants did not answer the question. Most participants were residents ($n = 48$), followed by specialists ($n = 22$), and the smallest groups were consultants ($n = 7$) and GPs ($n = 6$) [Figure 2]. Out the total, 58 (69%) had work experience of <5 years, whereas 11 (13.1%) had >10 years, 10 (11.9%) of them had experience ranging between 5 to 10 years, and only 5 (6%) had <1 year experience [Figure 3]. Their mean age was 33.97 (± 9.55) varying between 25 and 66 years. The proportion of females was higher 54.8% ($n = 46$) than the males at 45.2% ($n = 38$). The majority of participants had low level of awareness and management, with the general average at 1.90 (+2.19) and a percentage of 67.9%. Furthermore, the study indicated that the general knowledge was high as the average was 2.84 (+2.60) at 56%. The general knowledge of the participating GPs on MOE disease was better than their awareness and management. Nearly 56% of the participants did not have much general knowledge of MOE diseases, whereas 44% did. There was a statistically significant relationship between participants' knowledge and awareness levels. Significance was at the 0.01 level [Tables 2a and b]. Nearly 67.9% of participants had no awareness of MOE and its management, whereas 32.1% had awareness.

Nearly 90.5% of the participants said that diabetic patients were more at risk of getting otitis externa than normal people. 26.3% said they presented with Earache. Furthermore, our study proved that there was a relation between sociodemographic characteristics (Degree, duration of practice) and total score of knowledge and awareness, correlation was significant at level 0.05. The total number of correct and incorrect answers for each question and the evaluation of responses revealed that very few doctors had good knowledge of otitis externa and MOE. Small percentages of correct answers were observed when participants were asked about their awareness of otitis externa and MOE. However, there were statistical significances when responses to questions on practice setting and job titles of the participants were analyzed. Participants' demographic variables were analyzed with responses to questions to study the effect of gender, age, practice setting, and job titles. The gender of the participants did not have any significant effect on their awareness, management, and the diagnosis of otitis externa in general and MOE specifically. The risk factors associated with awareness of otitis externa and MOE were analyzed. Correlation of participants, socio-demographic variables, and general knowledge showed significance at a level of 0.01–0.05, respectively [Tables 3 and 4]. Furthermore, very few were aware of the risks of having MOE, for only 2 (2.5%) out of 80 responded correctly.

Discussion

In the literature, there is very little information about the importance of diabetes mellitus for ear diseases. To the best of our knowledge, this is the first article about awareness of MOE among physicians to invent the new nomination as a “Diabetic Ear” reported in the English literature. MOE was described in 1959 by Meltzer and Kelemen.^[10] It had associated with high mortality rates reached up to 50% when it was first characterized in 1968.^[11] Since that time, the link with diabetes is well established. With recent studies showed that the prevalence of diabetes in MOE to be between 65% and 95%.^[12-14] Through our conducted study, we found the lack of awareness and knowledge about MOE among Saudi residents, specialists, and consultants working in the primary health care in the Eastern province. This is worrying in the context of the fact that various studies reported a poor outcome for MOE.^[15,16] Accordingly, it raises our interest to find an alternative modality to increase the clinical suspicion for early diagnosis of MOE which supports the introduction of “diabetic ear” term. As it was reported that the individuals with diabetics are the patient’s group who most vulnerable to MOE.^[17] Substantially, the usage of the term of “Diabetic Ear” will facilitate in the successful management and minimize the complications of the MOE, through the early detection. In this study, the result was astonishing, about 96% of residents and GPs were not even aware about the risk factors which lead to MOE. Furthermore, their knowledge about complications of MOE was even worse 81% of GPs and Residents were having the wrong information. We also found that 31.5% of residents were not even aware about condition called “MOE” comparing to only 5.6% of residents whose have the complete knowledge about MOE. In this context, we emphasize the need for such term to increase the level of medical education and patient’s care. The failure to consider MOE in diabetic patients with otalgia that frequently leads to a delay in the diagnosis of MOE. On an average, seven months elapsed from the onset of typical MOE symptoms until establishing the diagnosis, even with a known risk factor, such as diabetes mellitus been previously reported.^[18] Diagnostic delay at a minimum leads to prolonged patient suffering rather than a higher mortality.^[19] In our study, the evaluation of responses revealed that the job duration and years of experience do not reflect the true level of knowledge in MOE among the physicians, where 95% of participants have > 5 years experience respond incorrectly to identify risk to have MOE among their patient; and only 15.8% they were aware of complications. The clinical suspicion of MOE should be raised in a patient with a discharging ear and deep-seated pain who did not get response to medical treatment and aural toilet, however, our data showed that few of residents were been able to

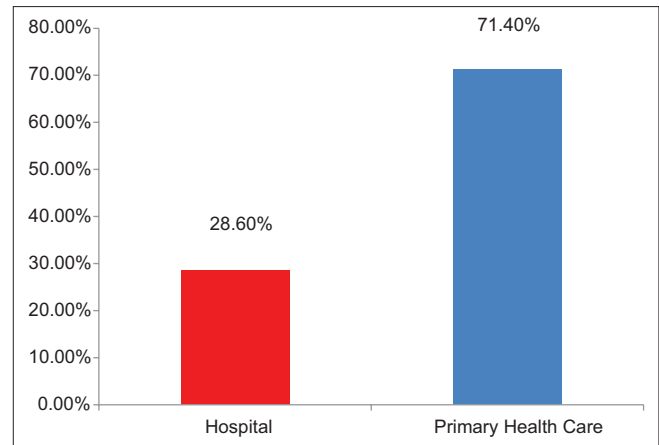


Figure 1: Practice setting

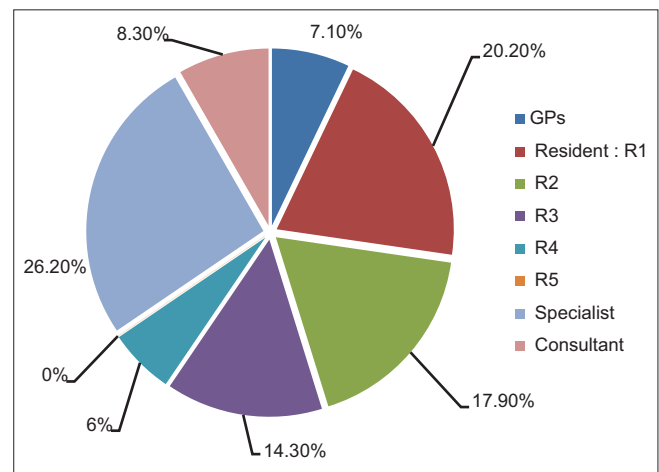


Figure 2: Practice distribution

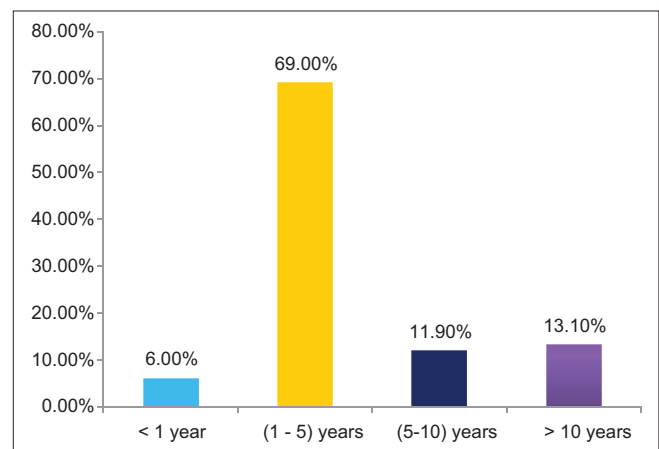


Figure 3: Duration of practice

diagnose MOE correctly and 79.3% did not even think about otolaryngology referral. We contribute that due to Initial symptoms are mostly indistinguishable from simple otitis externa. This emphasizes the need to introduce and be familiar with the term “Diabetic Ear”. Jacobsen *et al.* mentioned that, clinical presentation

Table 2a: Relationship between general knowledge and physician’s awareness and management, proves that there is statistically significant relationship between general knowledge and physicians’ awareness and management

Awareness	Knowledge		Total, N (%)	χ^2	p-Value
	Knowledgeable N (%)	Not Knowledgeable N (%)			
Aware	8 (21.6)	19 (40.0)	27 (32.1)	9.556	0.018**
Unaware	29 (78.4)	28 (59.6)	57 (67.9)		
Total	37 (100.0)	47 (100.0)	84 (100.0)		

**Significant at the 0.01 level

Table 2b: Correlation between general knowledge and physician’s awareness and management

	Knowledge	Awareness
Knowledge		
Pearson correlation	1	0.560
Significant (two-tailed)		0.023*
n	84	84
Awareness		
Pearson correlation	0.560	1
Significant (two-tailed)	0.023*	
n	84	84

*Correlation is significant at level 0.05

of MOE may overlap with or evolve out of benign otologic conditions or interventions, which may lead to a delay in its diagnosis. In the literature reported, it is usually only after multiple failed treatment attempts that MOE is suspected.^[20] The impetus for this study was the statistics we found that 90.2% of the residents did not consider otolaryngology referral or at least starting patients on aggressive management. From our experience, we have seen numerous patients with risk factors who have been managed by competent physicians for an intractable ear complaint, such as otorrhea and otalgia, but the diagnosis MOE had not been considered, and this may explain the delay in referral and poor knowledge among physicians. In this study, we identify common points of failure in the contemporary diagnosis and management of MOE related to poor knowledge. The mean diagnostic delay in the literature has been reported to be between 1 and 7 months according to Amrosa *et al.* This may need further studies to identify the defects for proper diagnosis and management of skull base osteomyelitis. Bone scans are sensitive test useful in monitoring disease progression which may not be available in all institutions dealing with MOE; however, our study showed only 6% were thought about it. On the other hand, computed tomography is a helpful study for the assessment of bony involvement and to confirm the diagnosis of MOE, but there was lack of awareness among the participants. *Pseudomonas aeruginosa* is the main causative organism^[21,22] In the present study, 45.3% of residents were not aware of common organism; furthermore, it increases the antibiotic resistance in *P. aeruginosa* represent another problem.^[23,24] Because of the improper usage of ear

antibiotics in the primary care, which affect the culture result to isolate the causative microorganisms from the external auditory canal (EAC) for suitable culture-base therapy as reported by Loh and Loh in 2013. In our study, 21.1% of residents were planning to give an IV antibiotic, 3.4% of specialists were be able to manage MOE correctly. The diabetes world wild is increase, subsequently, the incidence of MOE will rise. Berenholz *et al.* reported that MOE will become both more common and more difficult to treat due to many factors for these physicians should always maintain a high index of suspicion in susceptible patients. Our study concluded that the most effective way to onslaught the MOE is early detection of the disease by increase clinical suspicion of the “diabetic ear” to control diabetes and to attack the infection with the proper antibiotic, debridement necrotic tissue, and sometimes aggressive surgical management, accentuate the necessary to share a common term like “Diabetic Ear”.

Conclusion

From our survey we discovered a significant deficiency in the level of knowledge of GPs regarding skull base osteomyelitis (SBO) in the context of malignant otitis externa (MOE). Therefore, health education and awareness programs on MOE are recommended. Furthermore, we encourage the use of the term “Diabetic EAR” to increase the level of awareness of physicians about MOE. We recommend continuing medical education and training programs to update GP’s knowledge on the weak areas identified in this study. One of the practical solutions we aimed at in this study, since MOE is common among diabetic patients is to introduce a new term “DIABETIC EAR” by which we hope to facilitate awareness of MOE disease and improve health outcomes in this group of patients.

Limitations

First, surveyed participants were included only the Eastern province physicians, about their awareness and knowledge in the management of MOE, and this could be different in the other regions of KSA. Second, we tried our best to increase the response rate from the physicians; the nonresponders could be a potential source of bias in our results, but it will be the subject of

Table 3: Correlation of subjects, sociodemographic variables and general knowledge

Sociodemographic variables	General knowledge about MOE		χ^2	p-Value
	Knowledgeable N (%)	Not Knowledgeable N (%)		
Degree				
GPs-resident	17 (45.9)	38 (80.9)	11.158	0.001**
Specialist - consultant	20 (54.1)	9 (19.1)		
Duration of practice (years)			7.195	0.040*
<1	1 (2.7)	4 (8.5)		
1-5	28 (75.7)	30 (63.8)		
5-10	4 (10.8)	6 (12.8)		
>10	4 (10.8)	7 (14.9)		

*Significant at the 0.05 level, **Significant at the 0.01 level. MOE=Malignant otitis externa, GPs=General practitioners

Table 4: Correlation between sociodemographic variables and awareness

Sociodemographic variables	Physician's awareness and management about MOE		χ^2	p-Value
	Aware N (%)	Unaware N (%)		
Degree				
GPs-resident	10 (37.0)	45 (78.9)	5.509	0.034*
Specialist - consultant	17 (63.0)	12 (50.0)		
Duration of practice (years)			10.991	0.012**
<1	0	5 (8.8)		
1-5	7 (26.0)	51 (89.0)		
5-10	9 (33.3)	1 (1.2)		
>10	11 (40.7)	0		

*Significant at the 0.05 level, **Significant at the 0.01 level. MOE=Malignant otitis externa, GPs=General practitioners

future research to be included in a more comprehensive study.

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Conflicts of interest

There are no conflicts of interest.

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