An expert system for the diagnosis and management of oral ulcers

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Abstract

The present research was conducted to introduce a Visual Basic expert system to help the postgraduate students in the diagnosis and treatment of the most common and rare oral ulcers. A total of sixty postgraduate students shared in the study. They received the system on a CD-ROM and asked to evaluate it using a printed questionnaire. The oral ulcerative conditions merged in the database included, aphthous ulcers, chancre, traumatic ulcers, histoplasmosis ulcers, acute herpetic ulcers, burns, herpangina, tuberculosis, syphilis, gonorrhea, acute necrotizing ulcerative gingivitis, herpes labialis, herpes zoster, erythema multiform, Steven Johnson's syndrome. The conditions also included, allergy, Behcet's syndrome, neutropenia, necrotizing sialometaplasia, pemphigus, ulcerative lichen planus, vitamin deficiency, anemia, lupus erythematosis, epidermolysis bullosa, pemphigoid, squaemous cell carcinoma, desquamative gingivitis and others. Results showed that the mean overall scoring quality of the program was 3.0 ± 0.7 with 75% success rate. It can be concluded that the introduced expert system was helpful to the postgraduate students in the diagnosis and treatment of the most common oral ulcers.

1. Introduction

Oral ulcerations is a common mucosal disorder. It may be caused by physical or chemical trauma, viral, fungal or bacterial infections, allergy, malignancy or a manifestation of systemic diseases [1]. The process of oral ulceration causes a breach in the oral epithelium, which typically exposes nerve endings in the underlying lamina propria, resulting in pain or soreness, especially when eating spicy foods or citrus fruits [2]. As the majority of the ulcers require treatment of the underlying cause, proper diagnosis will lead to successful treatment and prevention of the lesions [1].

The arrival of the twenty-first century has suddenly forced on dentistry a new paradigm regarding expected standards for state-of-the art patient care. Traditional methods and procedures that have served the profession well are being questioned within the context of evidence based rationales and emerging information technologies [3].

In the area of dental informatics, the application of computer and information sciences to improve dental research, education, and practice has been particularly

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noteworthy and the use of electronic teaching tools and learning environments as CD-ROM or web-based has increased dramatically [4,5].

Expert system is an intelligent computer program that uses knowledge and inference procedures to solve problems at the level of a human expert. It emulates the decision making ability of a human expert in a particular field. The knowledge in expert system may be either expertise or knowledge that is available from books, journals, conferences, magazines, knowledge persons and internet [6].

So, the aim of the present research is to introduce an expert system for the diagnosis and treatment of the most common oral ulcers based on the algorithm of Morris (2004) [7].

2. Materials and methods

The knowledge database was collected from Burket's Oral Medicine (2008) [8], strategies in dental diagnosis and treatment planning of Morris (2004) [7] and many health care websites as Mayo Clinic. The data was classified, stratified, organized then transferred to the expert system database.

The expert system was developed using Visual Basic Ver. 5 language. The system contained many forms that welcome the user and start step by step to introduce the major descriptive categories of the oral ulcers whether occurring for the first time, recurrent or chronic in nature. Then starts to branch according to the user selections to reach the most descriptive condition that meets his or her patient. When the user selects the final condition, the corresponding form is located by the search engine and loaded to the screen displaying the diagnosis, the picture of the ulcer and the suggested treatment options (Figs. 1—3).

To facilitate the user in decision making, a backward button was added in all selection forms to revise or change the selection. Also to make the decisions without confusions the introduced selection options were programmed so that the user was not allowed to select more than one option.

The oral ulcerative conditions merged in the database included, aphthous ulcers, chancre, traumatic ulcers, histoplasmosis ulcers, acute herpetic ulcers, burns, herpangina, tuberculosis, syphilis, gonorrhea, acute necrotizing ulcerative gingivitis, herpes labialis, herpes zoster, erythema multiform, Steven Johnson's syndrome. In addition to allergy, Behcet's syndrome, neutropenia, necrotizing sialometaplasia, pemphigus, ulcerative lichen planus, vitamin deficiency, anemia, lupus erythematosis, epidermolysis bullosa, pemphigoid, squaemous cell carcinoma, desquamative gingivitis and others.

The compiled software was copied to CD-ROMs and distributed to 60 postgraduate dental students and house officers of Tanta University Faculty of Dentistry. The users were trained on using the software, asked to use it in their clinics and to fill a questionnaire about the size of the program, the loading time, the clarity of the introduced selection options, the number of correctly diagnosed ulcers and to score the quality of the overall program from 1(inadequate) to 5 (excellent) [9].

3. Results

The questionnaire papers were collected from the postgraduate students and data were tabulated and analyzed. So as to facilitate data scoring for statistical purposes the selection options were converted into numerical scores, the item "Not clear" = 0, "Confused" = 1 and "Clear" = 2. Also the overall scoring quality of the program were coded as "Inadequate" = 0, "Adequate" = 1, "Good" = 2, "Very good" = 3 and "excellent" = 4.

The mean scores for the included ulcers were represented in Table 1. The overall scoring quality of the program was 3.0 ± 0.7 with 75% success rate.

4. Discussion

Early detection of diseases enables their prevention and appropriate treatment. Computer based methods are increasingly used to improve that medical service [10].

The present research was conducted to introduce a newly developed concise expert system as an aid in the proper diagnosis and treatment of the most common oral ulcers for the postgraduate students. The oral ulcers were selected as they represent a common complaint of the outpatient clinics [11].

The percentage of diagnosis for the recurrent, first time ulcers and ulcers with well circumscribed borders was 90%, 85% and 85% respectively. Such results may be attributed to the increased prevalence of such ulcers. Also the percentage of the ulcers with ill defined borders, ulcers without systemic manifestations and multiple ulcers was 80%, 80% and 75% respectively. Results may be attributed to prevalence of such type of ulcers, the introduced data from the expert system and the back knowledge of the postgraduate students.

The percentage of diagnosis for the chronic ulcers, ulcers with purulent material, single ulcers and ulcers with systemic manifestations was 70%, 70%, 65% and 65% respectively. Such scores may be attributed to low

Fig. 1. The software layout showing the starting page.

prevalence of some of such ulcers such as histoplasmosis ulcer, oral chancre, ulcers of syphilis and gonorrhea, tuberculosis ulcers and ulcers of neutropenia. In addition to some difficulties in diagnosis due to presence of other systemic signs and symptoms that may confuse the postgraduate student or the data introduced by the system was not enough to reach a diagnosis. The expert system used in the present research was useful and the results were supported by many researches.

Expert systems were used in many fields, medically Smitha and Rohini (2010) [6] had used an expert
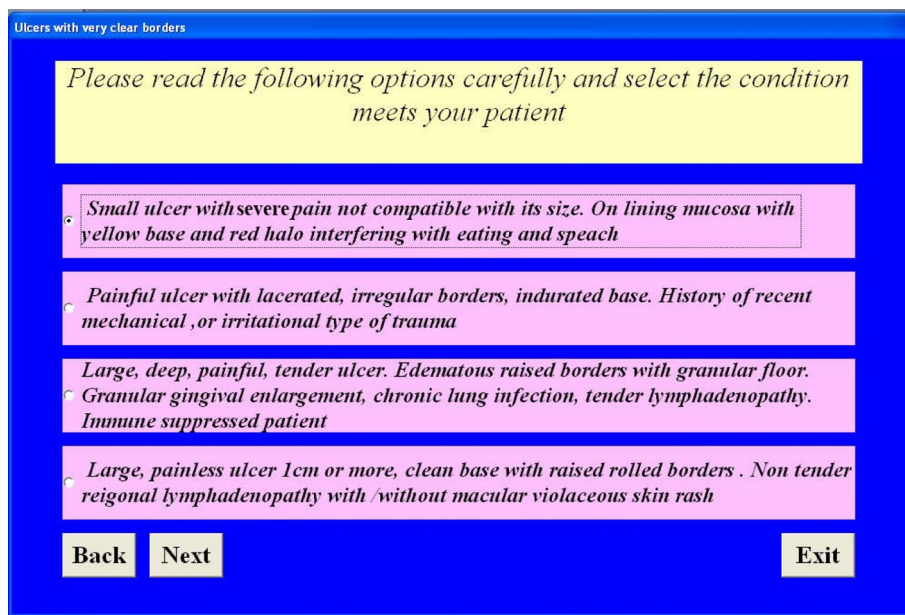

Fig. 2. The expert system showing the options for the ulcers with well circumscribed borders. The first option was selected.
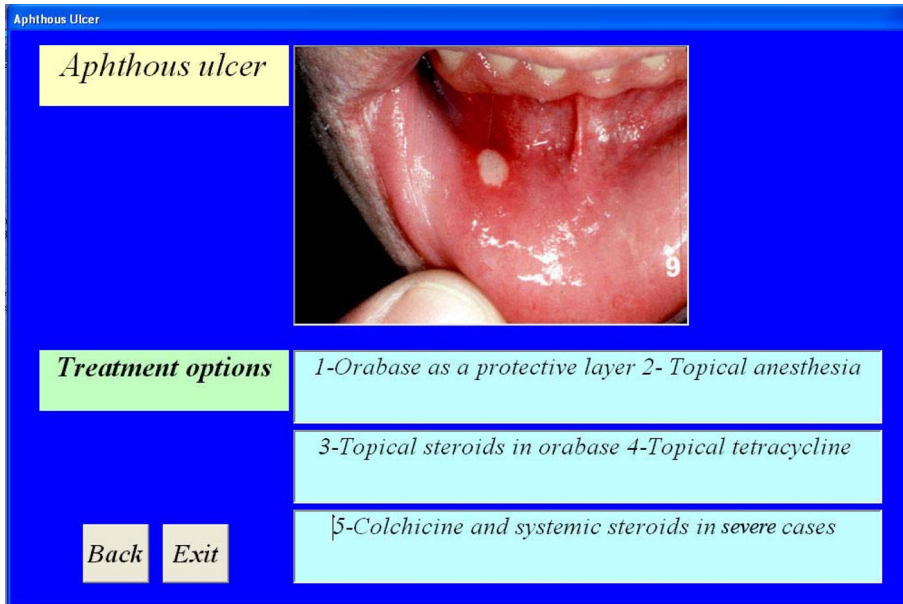
Fig. 3. The system displays the result of the selection of the first option.

system for the diagnosis of diabetes. Their system was able to decide whether the person was diabetic or not and his level of illness, possible complications and the most appropriate treatment plan.

Moreover Entacher et al. (2011) [12] had used the expert system in preoperative testing for patients before surgery. The system was used to collect the patient data as history, general information, and condition of lung, kidney, coagulation, drugs, heart and hematology. The collected data helped to prevent double examinations and unnecessary test to reach a proper diagnosis and treatment plan.

In the dental field Abbey (1987) [13] had used an expert system for the oral diagnosis concerning the periapical radiolucency. The system takes the patient data and links them to a large fixed database then suggests the causes and the management.

Table 1
Showing the mean scores for the ulcers with their detection percentage.

Ulcer	Mean scores	Percentage
First time	1.7 ± 0.3	85%
Recurrent	1.8 ± 0.4	90%
Chronic	1.4 ± 0.3	70%
Well circumscribed borders	1.7 ± 0.2	85%
Ill defined borders	1.6 ± 0.3	80%
With purulent material	1.4 ± 0.3	70%
Single	1.3 ± 0.5	65%
Multiple	1.5 ± 0.2	75%
Without systemic manifestations	1.6 ± 0.3	80%
With systemic manifestations	1.3 ± 0.3	65%

The results of the present research agree with those of Firriolo and Wang (1993) [14] who used an expert computer system for the diagnosis of selected painful pulpal conditions. The results were promising and successful in endodontic diagnosis.

Moreover the results of the present research agree with those of Mc Cracken et al. (2000) [15] who used a computer assisted learning package in the management of traumatized incisors for the general practitioners. They used a questionnaire to evaluate the overall program and 57% found it easily to use and improved their knowledge in the management of fractured incisors.

The results agree with those of Saudi (2002) [16] who used an expert system to help in decision-making and treatment of the most common periodontal conditions. The system idea was based on the collection of the patient's data such as age, oral hygiene, attachment loss, bleeding, recession, tooth mobility, alveolar bone loss, width of the attached gingiva, occlusion, and fitness for periodontal surgery. When the user selects an item, the system displays the available options which mostly influence the decision making in periodontal therapy. An alert database connecting module was developed to evaluate all entered data and the safest clinical solutions. Also the system could display and print a report for each case. The system was tried by 20 dentists and the mean agreement level was 82.3% in 30 periodontal conditions of 35 patients. It was concluded that the system was helpful for general practitioners.

Also the results agree with those of Xue-jun et al. (2006) [17] who had realized the use of expert system in periodontal disease. They used a Visual Basic 6.0 program to collect the patient data and compare them with those stored in the system to produce the proper diagnosis, prognosis and treatment plan. They concluded that the system was effective in diagnosis and the suggested treatment plans.

Moreover the results of the present research agree with those of Shankarapillal et al. (2010) [18] who used the neural artificial intelligence to test the accuracy of periodontal disease risk assessment. Data was collected from 230 patients concerning age, gender, family history of periodontitis, history of periodontal surgery, diet, smoking history, pan chewing habit, history of diabetes, history of hypertension, presence of sub gingival restorations, bleeding on probing, debris index average pocket probing depth, presence of root calculus, presence of furcation involvement and vertical bone loss. Periodontitis risk assessment was done on a grade of 1—5. Results showed that neural networks can be used effectively for periodontitis risk prediction.

Furthermore the results agree with those of Allahverdi and Akcan (2011) [19] who used an expert system for the diagnosis of periodontal diseases. The system receives the patient data including clinical and radiographic findings and determines the diagnosis, disease severity and the treatment methods.

It was concluded that the system helped the dentists by facilitating their job with the most correct diagnosis and treatment method. In addition, reducing time loss with some advantages compared with traditional diagnosis and treatment methods.

Based on the previous results of the current research, it seems that the introduced expert system may be helpful to the postgraduate students in the diagnosis and management of the most common oral ulcers. Although the artificial intelligence and expert systems may provide an additional help in many medical fields but the human expert factor could not be neglected as the human resources are more wise and merciful.

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