TECHNOLOGICAL INNOVATION IN CEREBROVASCULAR ACCIDENT PRIMARY HEALTH CARE

Juan A. Juanes¹, Pablo Ruisoto¹, Mª Auxiliadora Velasco², Juan José Gómez³

¹University of Salamanca (Spain)
²“Elena Ginel” Primary Health Care Center. Salamanca (Spain)
³Centro de Imagen y Tecnología del Conocimiento Biomédico, CITEC-B (Spain)
jajm@usal.es, ruisoto@usal.es, mauxi.velasco@gmail.com, juanjose@citec-b.com

Abstract

New technologies, headed by current medical imaging systems, are now being introduced as tools for the teaching of neurosciences, enabling quality training in different fields. In the context of medical training, brain imaging and data visualization have transformed the field, due to the possibility of being able to actually see the human brain structure and function in normal and pathological conditions. Our aim has been to generate an Information Technology application that will permit the interaction with and visualization of the contents necessary for the management of patients who have suffered a cerebral ictus, following the strategic recommendation of the Quality Program of the Spanish National Health Service, with a view to offering support to medical practitioners in primary care. Visual C programming, DirectX controls and Macromedia Flash have been the main languages and applications used for developing this tool. The graphic user interface is easy to use and facilitates the interaction with the information contained by the application in a graphic fashion. Its graphic design is simple, facilitating interaction with users by means of swift navigation through the program. Among other options, the application includes anatomical images of the cerebral vessels and radiological images obtained with different diagnostic techniques including Magnetic Resonance. It describes the most common signs and symptoms, together with information about how to manage and treat patients with ictus. Our application is flexible and interactive, favouring active learning and the building of knowledge concerning this pathology. Implications for training professionals dealing with vascular cerebral accidents are discussed.

Keywords: ictus, software, experiences in education; innovation
1 INTRODUCTION

In view of the magnitude of the problem, not only the need to establish suitable policies for the prevention of ictus is evident but also a search for organizational models of treatment with a view to reducing mortality and its sequellae is mandatory. Accordingly, appropriate information and a sound knowledge of this pathology, together with appropriate modes of action, should lead to an improvement in our attempts to decrease mortality and reduce its sequellae. The Spanish Foundation for Neurological diseases itself has underlined the need to implant ictus units with well trained professionals and suitable structures in all Health Centres, both in-patient (hospitals) and in Primary care. Additionally, the Ictus Strategy of the National Health System includes in its aims the improvement of attention to patients with prevalent diseases involving considerable social and economic costs, with the participation of experts in all the disciplines related to ictus events.

There is no doubt that Information Technology is changing the way in which teaching material is presented for life-long medical training. The new technologies, headed by new systems of graphic visualization of body structures, are beginning to be introduced into the medical environment, allowing pathologies to be simulated with great realism, which in turn enables higher quality medical training. Recent years have seen the introduction of different multimedia applications, which are of great use for programming medical training activities based on self-learning through IT supports.

With the aim of training in this cerebral vascular pathology, our aim has been to generate an informatics application, of a documentary nature, that will allow the necessary visualization and interaction for the assessment and appropriate management of this disease, with a view to serving as a support in medical practice in primary care, and assessing the symptoms derived from this type of clinical situation. Additionally, with this informatics procedure our aim is to develop abilities and skills through systems of interactive visualization that will facilitate the medical training process regarding this cerebral pathology, using complementary informatics teaching tools such as those discussed here.

2 METHODOLOGY

We used a type of software developed specifically in collaboration with the Image and Technology Centre of Biomedical Knowledge (CITEC-B), in Madrid. This is programmed in Visual C, which includes direct controls.

Macromedia Flash technology was also used, of great use for performing interactive multimedia applications. This tool can be used to develop dynamic teaching contents. The Flash technology allowed us to generate audiovisual material that permits the acquisition of knowledge in an attractive, rapid and efficient way. In the design of our informatics application, we assessed the way of presenting the teaching contents (on-screen composition and distribution in the search for a simple method of interaction and communication between the computer and the user).

The interface generated is easy to use. Its graphic design was selected carefully, attending to both its formal aspects (colour, distribution in space, etc) and aspects referring to interaction with users; i.e. by means of simple navigation through the program.

Our informatics application can be executed in the Windows 2000 environment, or XP, SP3, Windows Vista or Windows 7 of 32 bits. The minimum recommendable hardware requirements are as follows: a 1024 x 768 screen with a video card with at least 512 bits of memory; a 1.2 GHz processor (or higher), 1 GN of RAM and 1 GB of free memory on the hard drive.

All the information contained in the IT application came from papers and manuals specialized in the issue [1], [2], [4], [5], [6], [7], [8], [9], [10]. All the literature references are well references in our application.

3 RESULTS

Interaction with this informatics application affords users greater capacity to integrate and transfer knowledge about this pathology, conferring them skills in their daily clinical practice and a better understanding of clinical cases. The content of the IT application is structured in the following sections, which can be seen using drop-downs arranged in two rows (Fig. 1): cerebral vascular...
anatomy; the most common signs and symptoms; differential diagnosis; patient management; treatment; neuroimaging techniques; images; simulation environment; Bibliography; Glossary and additional comments.

Figure 1.- User interface of the IT application concerning ictus in Primary Care. Access to the different options of the program can be achieved through two text bars located at the top of the screen. The elements that integrate the content of the IT application are: cerebral vascular anatomy; the most common signs and symptoms; differential diagnosis; patient management; treatment; neuroimaging techniques; images; simulation environment; Bibliography; Glossary, and additional comments.

In the section dealing with cerebral vascular anatomy a description is offered of the carotid and verteobasilar systems, analyzing these by means of illustrative images with a textual description of the origin and course of each blood vessel (Fig 2).

Figure 2.- Screen for visualizing the anatomy of arterial vessels forming the encephalic circulation. Here we show images with a textual description of the origin and course of each blood vessel.
In the section addressing the most common signs and symptoms of an ischaemic accident there is a summarized description of the most relevant data: unilateral paralysis (weakness, clumsiness or heaviness, usually compromising one side of the body); language alterations (problems in understanding or speaking (aphasia) or faulty language (dysarthria), monocular blindness (painless loss of vision in one eye, often described as a “falling curtain”); vertigo (the sensation of rotation or turning that persists when resting); ataxia (lack of balance, stumbling gait, staggering, lack of coordination of one side of the body).

The drop-down under the heading of differential diagnosis allows users to evaluate other pathologies with which to establish a differential diagnosis; among them the following are important: haemorrhagic CVA; ischaemic CVA; cranioencephalic trauma; meningitis/encephalitis; hypertensive encephalopathy; intracranial mass; tumour; subdural/epidural haematoma; convulsions with persistent neurological signs (Todd’s paralysis); metabolic alterations; hyperglycaemia (non-ketotic hyperosmolar coma); hypoglycaemia; post-partum cardiac ischaemia; toxicological causes; endocrine disturbances (myxoedema); uraemia; psychiatric syndromes; shock, hypoperfusion of the CNS etc.

In the section on the management of patients suffering an ictus a description is given of the main actions to be implemented in these situations, as well as the well known actions on vital signs and general medical assessment.

The IT application includes videos that visually represent, in animation, the different steps in the development of an ictus in a patient and the clinical consequences deriving from this (Fig. 3).

**Figure 3.** On screen representation of the visualization of the formation of an ictus by animated simulation of dynamic images, showing the different stages and phases of the obstruction of a cerebral blood vessel.

In medicine, simulators are informatics systems that reproduce aspects of clinical practice and whose aim is to improve the visualization of a clinical process that will allow professionals to learn and train, both as regards as their individual activities and when working as a team. The usefulness of a dynamic visual system is based on the possibility of faithfully reproducing some aspects, such as how a pathology develops, carefully representing the different clinical aspects.

In the section referring to the treatment of this type of patient, the mode of action is detailed, underlining early recognition of the process and the rapid choice of priorities, evaluation, and
definitive management protocols. Early treatment to a large extent depends on the patient or his or her relatives or circumstantial spectators recognizing the episode, such that good information about this pathology is essential.

Our informatics application includes the main diagnostic imaging techniques for the identification of the pathology (Fig. 4). We describe both techniques for morphological assessment (arteriography, computerized angiotomography magnetic angioresonance, colour Doppler ultrasound) and techniques for functional assessment of the image (PET, single-photon emission computerized tomography).

![Image of diagnostic techniques](image)

**Figure 4.** Visualization of the image file screen, with different image diagnostic techniques, with respect to cerebral vascularization and its pathology. By clicking on the image this appears in a larger format for better evaluation, together with an additional comment in the lower part of the screen.

In the comments drop-down, we describe the most important aspects related to CVA, their location, severity, frequency, classification, etc.

In the glossary offered in the informatics application a description is given of the main abbreviations used in the management of these patients; these are in general use in daily clinical practice.

Finally, the IT environment allows users to access a good file on bibliographic references that complements the information supplied by the application itself. Thus, it is possible to access an excellent bibliographic source concerning this brain pathology.

The interaction between the application and the user allows the latter to establish a set of stimuli able to compete with other communications and information media such as classic medical textbooks.

Correct use of these digital resources in medical training offers a technological means that allows training in the current needs of society.

4 DISCUSSION

Ictus is an important health problem. It is one of the first causes of death in the West and the first cause of incapacity and professional costs. Each year in Spain 100,000 new cases of ictus appear, most of them among people older than 65, although such episodes are also known to appear in young people and children. The fact that its development is more likely in older individuals means that it affects women more than men since their life expectancy is longer.

Statistics confirm that following an episode of ictus one third of those affected die during the first
month, while 40% of those who overcome the first stages develop a degree of incapacity that does not allow them to live autonomously. Only one third of those affected recover most of their basic functions and can return to normal activities.

The clinical diagnosis of ictus is difficult, owing both the richness and broad variety of its clinical expression and the need to perform a diagnosis as soon as possible after the episode. In recent years, progress in neurological understanding has been exponential on both the basic side and in clinical practice. All this means that we now know the specific causative agents better, along with their pathophysiology, pathogenesis, etc… 10, 11, 12, 13. However, a lack of knowledge about ictus persists and the gap is deep. A questionnaire given by the Groups for the Study of Cerebrovascular Diseases (GEECV, Spanish Acronym) revealed that only 4% of the population were aware of the meaning of the term and that only one out of 10 consulted was reasonably knowledgeable about the causes of the disease and preventive measures 8. Currently this figure has risen to 27%.

In light of the above, the use of manuals and support materials in training in this pathology and appropriate management of patients are crucial. In this sense, IT technology applied to medical training has seen many changes in recent years, paralleled by the technological revolution occurring in our society. IT-based teaching programs have also undergone noteworthy changes in recent years. Scientific research itself as the basis of human progress has led many instructors and scientists to believe that this could herald a new age in education and training practices in medicine. This evolution has been provided by both technical support elements, i.e., the hardware used, and by the contents transferred through IT programs. i.e. the software. The meeting of both has led to methodological changes in knowledge transfer and hence changes in the teaching-learning systems. In keeping with these notions, our application offers an efficient training tool in the pathology of such cerebral accidents.

The application of informatics technologies in training should help to broaden our margins of action, decision and intercommunication among professionals and patients, also allowing access to the new media for exploring, representing and treating knowledge 14, 15. The development of user interfaces has undoubtedly enriched interactions with the receiver, multimedia applications being those that have generated the greatest diversity of interface options.

The recently increased technological advances are now allowing us to handle custom-designed tools, which facilitate the elaboration of interfaces for computerized teaching programs in a simple and rapid way so that they can be used as complementary teaching materials in daily medical practice and as support material 3.

Good interface functionality will also entice users when they discover that little effort is required in the use of the IT application, allowing them to explore it, simply and fast.

There is no doubt that a good medical training will improve the most appropriate management of ictus patients, with repercussions on the patients and a reduction in health costs. Accordingly, actions aimed at teaching such as the application proposed here, together with strategies set out by the National Health System, should in the future be an approach to improving the medical care of patients with ictus.

5 CONCLUSIONS

The development of IT applications, increasingly more advanced, for the study of different pathologies is steadily being incorporated into the field of medical training, generating much valued programs for learning.

Interaction with this IT development allows users in primary care to have greater capacity to integrate and transfer knowledge about this pathology, conferring them skills in diagnosis and a better understanding of concrete clinical cases.

The incorporation in medical training of interactive support materials complementary to face-to-face teaching methods is becoming increasingly important in effective competition with the technological media now confronting modern society.

The use of IT teaching programs such as the one proposed here is an important step in, and analysis of, the teaching contents to be transmitted, together with a carefully designed presentation, so that the message and knowledge to be transmitted will reach users most efficiently.
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REFERENCES


