Computers in Otorhinolaryngology; New Horizons

KK Handa, Assistant Professor

RC Deka, Professor & Head

Deptt. Of Otorhinolaryngology, Head and Neck Surgery ,
All India Institute of Medical Sciences, New Delhi - 110029.

Abstract

There has been an explosion in the computers and information technology in the past couple of years. Otorhinolaryngology has also seen a number of new applications of computers. This article aims to familiarize the reader with different uses of computers as applied to the field of Otorhinolaryngology. It deals with the role in medical literature search, patient and doctor education, medical record keeping telemedicine, internet and E-mail, creating virtual environments and its role in FESS, skull base tumours and plastic surgery.

The present age has very aptly been labelled as the information age. The maximum advances in the last couple of years have in the field of information technology and computers. These advances have also not left our field of Otolaryngology untouched. These advances have evolved very rapidly and are still progressing. In the present day the conventional surgical procedures are being replaced by minimally invasive and non invasive procedures aided by computers and information age technologies. The start was heralded by endoscopic sinus surgery. The techniques employing minimally invasive surgery have been further helped by three dimensional imaging e.g. for virtual endoscopy (1). Virtual reality simulators are useful in the area of medical education and training e.g. for temporal bone dissection and endoscopic sinus surgery.

We are in the process of leaving the past ear of surgery with hands and going into the next ear where a host of information age technologies such as computers, micromachines, three dimensional visualization, virtual reality and human interface technologies are going to change our total approach to the patient care.

The computer has become an important part of the Otorhinolaryngologists armamentarium be it his office, home or clinic. Those of us who are not able to keep pace with the present computer age may tend to lag behind professionally. Hence it becomes important to understand the application of computers as applied to the field of Otorhinolaryngology.

Medical Literature Search

Searching medical literature has become one

of the popular uses of the computer. Initially the use of computer for medical search was only for research or manuscript preparation but now it is increasingly being used for patient care and clinical problem solving (2). This is helpful in proper diagnosis, choosing the best diagnostic test and in treatment planning (3).

The quality of literature search is assessed with relation to 2 variables: recall and precision. Recall refers to the fraction of relevant citations retrieved with a search as compared to the total number of citations present in the literature. Precision refers to the number of relevant citations retrieved with a search as compared to the total number of citations retrieved with the search.

National Library of Medicine (NLM) of USA has compiled the information retrieval system called the Medical Literature Analysis and Retrieval system (MEDLARS). MEDLARS consists of 40 online databases of which MEDLINE is one of the popular databases. The website of NLM is <http://www.nlm.nih.gov>. Grateful Med is the popular interactive software package that allows users to perform effective searches using MEDLINE and other databases of National Library of Medicine (Table 1)

Starting from 1997 the NLM has started providing free unlimited access over the World Wide Web. Apart from NLM there are other vendors who licence MEDLINE and other databases. Some of these are paid while the others are free. A number of databases are available on CD-ROM e.g. Elsevier, Knight Rider. The cost of maintaining CD-ROM database is slightly high.

Relevant searching depends a lot on the users efficiency. To translate a question into a search query the user should break down the question into concepts. MeSH terms are the vocabulary used to categorize concepts in MEDLINE and other databases. These MeSH terms constitute a thesaurus that has all the concepts appearing in the literature. All scientific articles

are indexed into Medline using about 10 to 12 MeSH terms which describe the contents of the article. Medline and the other databases allow the use of Boolean logic to improve the search quality. Once the MeSH terms have been searched separately, these are then connected using the Boolean operators : AND, OR or NOT.

Telemedicine

It is most aptly described as the electronic transfer of technology with multiple applications. Though the idea had been practiced as early as 1959 in a primitive form however it is only in the recent times that telemedicine has really caught on. A study done in the field of Otorhinolaryngology has shown how telemedicine can help in management of vertigo (4). A two way digital video and audio was used to take the patient history and do the examination in vertigo patients when both the patient and the doctor were sitting hundreds of miles apart. Diagnosis and treatment is provided by the remote tertiary consultant under the care of the primary health care provider.

Telemedicine is bound to cut the cost of rendering medical services especially where the particular specialists required are available only in the difficult to access tertiary care centers. Internet can also be used as a telemedicine tool. This is done using the mailing lists. The subscribers discuss mainly on line cases with each other through E-mail. The currently available and widely used mailing lists are shown in Table 2. Another website available for patients is <http://www.cyberdocs.com>.

However 2 issues are preventing. Telemedicine taking over in a big way. The first is about the medico-legal stand point of Telemedicine advise. Secondly there are pending law suits in USA about the patent and the licensure of Telemedicine. Both these issues need to be addressed to seriously.

Medical Records

Keeping medical records is an expensive and time taking task. It has been seen the 35% to 39% of the total hospital costs have been spent in patient and professional communication (5) while 38% of a physician and 50% of a nurses time are spent in patient related paper work (6). Medical data is required for research, developing meaningful budgets, proper resource use and for insurance claims. Hence in the present times most of the good medical institutions are shifting to computerized patient records.

Some features of a good CPR are

- Easy method of capturing large volumes of data
- Intuitive interface
- Automatic creation of as much documentation as possible
- Automatic reminders and alerts to improve patient care
- Billing and scheduling
- Must be available to different users in different locations
- Fast review of data

The extent of CPR use in the doctor's office will depend on developing the appropriate software and hardware and making the users familiar with its use.

Internet and E-Mail

A network is a physical link between computers which may be local or farspread. The networks which are linked together form an internet. The word internet commonly used today refers to a global network of networks joined together by a common language TCP/IP. Though this technology is old and was used as far back as 1969 by the department of Defense to maintain network function in case of destruction of any intermediary point. However, it has caught on in a big way in the last

couple of years. The present day internet consists of millions of computers with unique addresses allowing them to work as information stations and conduits for information.

The number of users by middle of 1997 was estimated to be 19 millions (7). This sudden increase in the number of internet users was due to some evolutionary changes in the technology. These included the ability of the average desktop computer to handle high quality images and multimedia, availability of new technology where eas cheap modems and telephone lines could transmit data at high speeds. The two most commonly used applications of the internet have been E-mail and the World Wide Web. E-mail or the electronic mail provides fast and effective communication while the World Wide Web provides vast amount of information on any topic. Other less widely used internet applications include real time text based conversation e.g. internet relay chat, newsgroups (public messages are displayed) and old computing applications e.g. telnet.

World wide web; The web allows a number of resources to be retrieved in a common manner (known as HTTP, or hypertext transport protocol) independent of the computer being used to access the internet. It specifies a specific code for each resource known as Uniform Resource Locator (URL). URL's being specifying the type of source which is usually http:// indicating a web page. Pages linked together on the same computer that are built on the same subject are called as a Web site. The TCP/IP protocol is the common language which makes the internet work. HTML (hypertext markup language) is the common language in which web pages are written and it is generic. Each computer trying to access the Web has a program called the browser. The commonly used browsers are Navigator and Internet Explorer.

Network searching can be done in three ways i.e. using specific directories, general directories and search engines. Specific directories are kept by sponsors, departments or individuals.

Each specific directory has a particular address. General directories try to cover the entire web e.g. yahoo. Search engines employ brute force technology to comb the web. Lycos is one variety of search engine. However, the engines are not very specific.

Archives of Otolaryngology. Head and Neck surgery have a site www.ama-assn.org/public/journals/otol/otolhome.htm. This is an example of a site providing a host of features including article abstracts, readers information and course news. Web based CME programs are becoming increasingly popular. Another feature which is catching on is web based publishing. Though this tends to cut on the costs, publishing delays and more articles can be put up however, there are certain controversies associated with on web publishing (8). Internet also allows digitilised voice conversation between to persons by means of Telephony for the minimal price of internet access.

E-Mail; Electronic mail has made communication faster and cheaper. It can be received from anywhere in the world and is very easy to send. Multiple copies can be send and the transmission is very easy i.e. networking requirements are very minimal. All E-mail addresses follow a standard pattern. The word to the left of @ is the name by which the host computer identifies the user. The words to the right of @ represent the address of the host computer. However, one disadvantage of E-mail is the lack of security and confidentiality.

A mailing list is a specific arrangement where the user requests to be placed on a list of people interested in a specific topic. A program known as the list server maintains the list of the subscribers and coordinates the mail traffic. E-mail on the particular topic is send via the list server to each subscriber. Any one with an E-mail address can join an subscribers list.

List administrator has the responsibilities somewhat like an editor. Some examples of frequently used mailing lists are

- Voice disorders.... ronald@bcm.tmc.edu
- Dysphagia.... majordomo@cyberport.com
- Dizziness.... majordomo@samurai.com

Virtual Reality

Computerized 3-D imaging and robotics and create a realistic environment where surgeons can practice complex procedure. A computer co-ordinates the information from CT, MRI and ultrasound to build a 3-D dataset. Once the data set is complete the 3-D image is formed. The viewer can manipulate the image, cutting out areas and shading and coloring sections to enhance contrast or signify the anatomical and vascular regions. Virtual reality modeling language is a way of describing three dimensional objects in compact form. Special software is required at the users end.

Education

Doctor's Education; In the West computer training and computer based education are being given a lot of importance in the medical curriculum. Most medical schools have computer laboratories. Most of the students have a computer and an E-mail account. For doctors in practice this computer education can be learnt through courses, self study or under peer guidance. However, there is no better teaching than start using the computer oneself and learning. Most of the traditional learning materials are being replaced by CD-ROM textbooks and journals. In the field of Otorhinolaryngology several textbooks are available on the CD-ROM.

Patient Education; The interactive programs where the patient actively participates are fast replacing the old methods of patient education like brochures, handouts etc. Computers are now able to deliver full motion with full screen video. This has helped a lot in forming interactive patient programs. Internet can also help in this.

Clinical Applications

Computer Assisted Endoscopic Sinus Surgery

This procedure has been evolved keeping in mind increased intra-operative patient safety. It helps the surgeon in revision cases and the disease removal is more thorough. This computer aided surgery provides a direct interactive link with the patients preoperative CTS can or MRI. Direct endoscopic visualization only provides a keyhole view of the sinuses. While this procedure gives very good information about the surrounding anatomy. The monitor provides an image of the endoscopic view in context of the surrounding anatomy (9). This technique is very useful and increases the safety in procedures like optic nerve decompression, pituitary and skull base surgery. A multicenter study (10) involving eleven surgeons who performed fifty five surgeries showed that in 60% cases the confidence, understanding of the anatomy and the ability to correct patient's disease were increased.

Skull Base Tumor Evaluation

Skull base tumors are difficult to treat and diagnose as they lie in difficult to access areas. Hence any modality which allows better understanding of the surrounding anatomy of the tumor will improve the choice of the surgeon's approach resection and reconstruction. High performance computing allows the surgeon to

explore and interact with the image data in an intuitive manner, a manner in which he or she is used to dealing with, in volumes and three dimensions. In order to provide this clinical use through simulation technology, intuitive and low cost dexterous interfaces are combined with high volume graphics to produce a system that visualizes skull base anatomy in a very effective manner. The ability three dimensional reconstruction is possessed by most modern day scanners. Three dimensional viewing studies give a better visualization of the lesion and better understanding of the anatomical relationships. This is useful in pre-operative assessment of head and neck tumors, area of syndromic craniofacial reconstruction in pediatric patients and in facial skeletal trauma (11). These three dimensional images allow good tumor visualization and a better understanding of the spatial relationships.

Plastic Surgery

The computer has been used as an expert system to help the surgeon decide the best operation or a specific problem. An expert system is a flow chart summarizing an expert's approach to a certain problem. The computer functions through the use of an algorithm written into software. A good example is the rhinoplasty simulator (12). These programs have also been for midface advancesments and mandibular osteotomies.

Table (1)

Databases Maintained by National Medical Library

Aidline	citations on the AIDS literature
Aidsdrug	substances being tested on AIDS related trials
Cancerlit	citations on cancer literature
Healthstar	citations on health service technology
Histline	citations on history of medical literature
Medline	citations on biomedical literature
MeSH	thesaurus of biomedical related terms
Spaceline	citations to space - life sciences literature

Table 2

Commonly used mailing lists by otorhinolaryngologists

Nose	mailbase@mailbase.ac.uk
General Otorhinolaryn.	ronald@bcm.tmc.edu
Facial Plastic Surgery	FACEnet-request@tail.uchsc.edu
Otology	request@ears.com
Pediatric ORL	ronald@bcm.tmc.edu

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