NEW HORIZONS

TELEMEDICINE
A Revolution on The Horizon

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Introduction

Telemedicine can be broadly defined as the use of tele-communication technology for transfer of medical data from one site to another. The application brings *"health care on line"*.

A telemedicine system can be as simple as a computer hook-up or as advanced as" robotics-surgery" facility. Varied branches of medical specialities such as cardiology, pathology, neurology, psychiatry, dentistry, nursing, geriatrics, dermatology, ophthalmology, otolarynogology, endoscopy, emergency care, home health care and rural tele-medicine are at present in practice in telemedicine. The telemed specialists make either elective applications for making diagnosis or tackle medical emergencies by inter-physician communication or by direct physician-patient contact.

Tele-Cardiology

Tele-Cardiology has been in practice for the last two decades and includes trans-telephonic electro-cardiography, echocardiography, angiography, stethoscopy and tele-transfer of haemodynamic, blood gas and bio-chemistry parameters for intensive cardiac care services. Tele-cardiology centres are expanding all over the world including India.

Trans-Telephonic Electro-Cardiographic Monitoring (TTEM)

Trans-Telephonic ECG technique was applied for the first time in the beginning of the century. Einthoven investigated transmission of an ECG over a telephone line in 1906 (1). Sodi Pallers in 1984, introduced this technique in Mexico using one-lead transmission. It is well known that majority of deaths due to acute myocardial infarction are related to time factor as 60% of mortality is within first 4 hours of the event.The time-delay between onset of symptoms to accurate diagnosis and initiation of therapy is the most important determining factor for patient survival. For initiating pre-hospital care and thrombolysis, time is of essence as the best results are obtained when cardiac muscle is salvaged within the "Golden Hour" (2–4). TTEM was started at Escorts Heart Alert Centre (EHAC) at New Delhi., on 17th may 1996 (5–9). The accuracy of ECG recorded by cardio-beeper in comparison with coventional ECG has been accepted (10). Life-long TTEM is recommended

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in patients with pacemakers to detect possible battery depletion, lead or electrode malfunction that may need reprogramming or battery replacement (11, 12) and to follow patients with Automatic Implantable Cardioverter Defibrillators–AICD (13). Other applications are diagnosis of arrhythmias that are difficult to detect by Holter, follow up of arrhythmia treatment, evaluation of syncope (14), transient symptomatic event detection, patients with high risk of sudden cardiac death (15-18), home-rehabilitation programme', patients after coronary artery bypass graft surgery (CABG) or after coronary angioplasty (19-23). In Post-MI period, TTEM improves quality of life and helps to reduce the first year mortality (24, 25).

At present easy-to-use silver electrodes are available for proper skin contact, without need for any adhesive tape, sticking material or jelly. Earlier, beepers recorded 1 or 2-leads. They were useful only in monitoring cardiac rhythm. Now 9 and 12-lead recorders are available, the latter having a lead by lead display on a small screen on the beeper for instant diagnosis of rhythm disorder or ST-segment deviation.

In our experience over 30 months (May 17th, 1996 to October 18th 1998) 1161 patients were registered at EHAC from more than 130 cities from India and abroad. Medical history of patients was : Post -CABG 395 (34%), post–PTCA 163 (14%), chest pain for evaluation 151 (13%), arrhythmias 139 (12%), evaluation of palpitations 136 (12%), Post–myocardial infarction 128 (11%), chronic angina 103 (9%), PPM/AICD, 10 and 5 patients respectively. In the monitoring station we received 1863 symptomatic calls, 1604 (86%) calls were for cardiac symptoms and 259 (14%) were for non-cardiac symptoms. Sixty nine patients were called for acute hospitalisation. Average time delay between patients' symptoms and contact with Heart Alert Centre in our study was 30 minutes. We have found that TTEM helps to avoid unnecessary hospital admissions. Majority of patients (80%) can be managed with re-assurance and re-adjustment of medicine during the telephonic consultation. Those having real emergency are advised immediate hospitalisation, thus avoiding delay in instituting acute therapy such as thrombolysis and antiarrhythmia therapy.

Tele–Echocardiography

Tele-transmitting 2-D echocardiogram and colour doppler flow images, from remote areas to referral centres has become possible with use of special technology, viz; broad band, Integrated Services Digital Network (ISDN), fractional T-1 and standard phone lines. Video-conferencing equipment utilising ISDN technology is a reliable method for transmitting full echo-data, which is particularly helpful in paediatric cardiology practice, where rapid and accurate diagnosis of complex congenital cardiac lesions is life-saving (26, 27).

Medical Video-Conferencing

Provides live interaction between physicians situated at distant hospitals. The equipment involves video-cameras at peripheral and referral institutions, linked by ISDN digital lines or satellite links with a central station.

In 1998, National health service in UK has started medical video-conferencing programmes for providing emergency care services. Senior faculty provides "face-to-face" consultations from Royal Brompton hospital to the patients at Harefield hospital and to hospitals in Greece and Portugal. This has ensured that

patients receive expert advice irrespective of distances from a centre of excellence.

In May 1998, the European Congress of Epileptology and Pan-American Congress of Epileptology held a video-conference linking London, Warsaw, Dakar and Senegal to discuss the challenges for epileptology in year 2001. China's Telecom Bureau and Beijing Telecom Bureau have created China's first emergency mobile video-conferencing network using VTELS-TC 2000 systems at 47 sites across the country. This has drastically reduced travel-expenses and critical-care-time.

Tele-Medicine and Army

The US Army's first portable telemedicine unit was started in 1993 comprising "Ruggedish" video-conferencing unit. The unit was operating under the United Nations in Macedonia in 1994 and later in Haiti. These experiences have proved to be adequate for majority of clinical telemedicine cases and provide major benefit to the commanders in the field, by reducing evacuation rate and air-lifting which are hard on men and materials particularly in times of hostilities.

Tele-Radiology

Tele-radiology is claimed as most mature telemedicine application. In late 1950, the work started in Montreal and by 1990 technology was largely tested and found acceptable for all but a small subset of cases with very high resolution demands such as mammography (28).

State-of-art is reflected in development of filmless direct-digital-technology (DDT); Its advantages are:

- Elimination of films and processing chemicals.
- No film processing delay.
- Direct assessment of images, which eliminates need for expensive film digitisers.

As on 1997, in USA alone, there were 13 programmes, involving 2,43,000 diagnostic cases per year. Each program serviced average 7.3 remote sites. Cases included radiographs, CT scans, MRI and ultrasound pictures. Diagnostic teleradiology is steadly growing all over the world. *The main reasons behind its success are :* It saves travel time for radiologists to visit distant hospitals for seeing films, reduces the time delay between preparation of report and its receipt by the referring physicians; particularly in case of emergencies and has enabled high quality service despite shortage of radiologists.

Tele–Pathology

In April 1968, first tele–pathology (*From scope to screen*) interaction took place in a study of 1000 patients, between Massachusetts General Hospital and a medical station at Logan International in Boston. A black and white camera attached to microscope at medical station was used to transfer real time dynamic image of peripheral blood smear and urine sediments to Massachusetts General Hospital, using a microwave link. The picture quality appeared to be adequate. In August 1986, there was a successful transmission of colour images of frozen sections of breast biopsy from Texas to a high–resolution telemedicine monitor in Washington DC via Comstat satellite (29-31). Since then many centres have developed in Europe and in USA. The comparison between standard light microscopy and tele-microscopy studies showed that the readings were accurately matching each other. Tele–pathology is either dynamic or static–which are analogous to interactive video (IATV) and store & forward (SAF) techniques respectively. In dynamic tele–pathology there is a real-time interactive exchange between two or more individuals using IATV technology. The system uses a

video camera lens in place of the eye piece on the microscope. The image under the microscope is directly transferred to the receiving centre, using a video signal. In the SAF technique, the images are first stored and then forwarded. This technique is cheaper than the former (32).

Tele–pathology services have enhanced the ability to confer, educate and communicate to the referring physician, which in turn provides better service to increase the consultation base. Equally important is the decreased expense and time investment. Earlier, consultation could take many days for reports to be prepared. Many times, the consult slides were lost, broken, mixed up or not returned. Telepathology services provide a direct contact, the images can be stored permanently and are available for repeat consultation. They can be sent to many experts at the same time who can make real–time interactions among themselves.

Tele–Psychiatry

Increasing number of studies have identified essential issues, related to the utility, quality and reliability of video–conferencing e. g. interactive television in mental health care in Scandinavian countries and in Australia (33, 34).

Better resource utilisation have been established by saving expense and travel time of patients and psychiatrists. The issue of "diffusion" has been raised *i.e.* to what extent the psychiatrist will accept and integrate this technology in their day–to–day clinical practice (35).

Tele–Neurology

20 channel, digital electro-encephalograms, using data compression have been successfully transmitted telephonically. The guidelines to be followed for transmission, interpretation and storage of EEG have been laid down by American electro–encephalograph society (36).

Tele–Dermatology

The UK multicentre Tele–dermatology trial, in which centres from Ireland, Manchester and New–Zealand participated, have recommended that clinical management of dermatological conditions is possible via real–time tele–dermatology. The final phase of this trial is under process which aims for evaluating cost of management and mis-management, both to the patient and national health service (37).

Rural (Community) Tele–Medicine

Telemedicine has the potential to provide routine and specialist services to both patients and physicians in rural areas. The technique is particularly valuable in paediatric patients, in patients with acute medical emergencies and those suffering from accidental injuries. Since specialist facilities are located in large cities, physicians in remote areas feel deffident in handling serious patients, due to lack of experience and expertise. They, thus, transfer acute patients to far off referral centres, who become further sick as they do not receive even basic initial resuscitative support. If the rural physicians tele-link with big hospitals and with their seniors, they would have the confidence to initiate elementary care to sick patients in consultation with the experts and thus transfer them only after stabilising. The rural physicians would feel protected in case of medico-legal sequele as the responsibility is shared. Another advantage of telemed link is that the rural physicians would not transfer the un-deserving patients with non–serious ailments. Further, the rural physicians would not feel isolated from the mainstream medicine, they would remain in constant touch with the new advances like their peer group in

es. The brain-drain of trained doctors from rural to an areas will be halted (38).

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