Video clip transfer of radiological images using a mobile telephone in emergency neurosurgical consultations (3G Multi-Media Messaging Service)

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Abstract

Background. The purpose of this study was to validate and assess the accuracy and usefulness of sending short video clips in 3gp file format of an entire scan series of patients, using mobile telephones running on 3G-MMS technology, to enable consultation between junior doctors in a neurosurgical unit and the consultants on-call after office hours. Method. A total of 56 consecutive patients with acute neurosurgical problems requiring urgent after-hours consultation during a 6-month period, prospectively had their images recorded directly on the hospital’s Patients Archiving and Communication System (PACS) and this was compared with the neurosurgeons’ response. Results. Both neurosurgeons involved in this study were in complete agreement with their diagnosis. The radiologist disagreed with the diagnosis in only one patient, giving a kappa coefficient of 0.88, indicating an almost perfect agreement. Conclusion. The use of mobile telephones to transmit MPEG video clips of radiological images is very advantageous for carrying out emergency consultations in neurosurgery. The images accurately reflect the pathology in question, thereby reducing the incidence of medical errors from incorrect diagnosis, which otherwise may just depend on a verbal description.

Keywords: consultation; mobile phone; neurosurgical emergency; teleconference.

Introduction

The use of mobile telephones for transmitting critical medical data, especially in emergencies, is on the rise. In a paper by Istepanian, the term m-Health was defined as emerging mobile communications and network technologies for healthcare. It represents the evolution of traditional e-health systems from desktop platforms and wired connections to the use of more compact devices and wireless connections.¹

In the field of emergency neurosurgical consultations, several authors, including ourselves, have proposed the use of mobile telephones.²,³ This method is useful when consulting on problems such as head injuries and intracranial haemorrhages and it involves transmitting single CT images in a JPEG format using multimedia messaging services (MMS) over a standard mobile telephone line. However, problems using this technique result from the fact that discussions are carried out over a single image that has been selected to best represent the area of interest. If further images are required to make the necessary decisions, these new images have to be sent individually, which takes time.

The purpose of this study was to validate and assess the accuracy and usefulness of sending short video clips in 3gp file format of an entire scan series of patients, using mobile telephones running on 3G MMS technology. This was to enable consultation between junior doctors in a neurosurgical unit and the consultants on-call after office hours.

Materials and methods

All video images were obtained using a variety of mobile telephones with MMS and video recording capabilities. The inbuilt cameras in the mobile telephones used in this study had resolutions ranging from 3 to 5 megapixels. The images were recorded directly from the screen of the CT scan console by scrolling down the images. The video setting on the mobile telephones was adjusted to ‘sharing mode’ and this generally allowed a 20-sec clip with a maximum of 300 kbs of data per clip in 3gp file format. This is a stripped down format of MPEG files that allows transmission over the mobile network using the MMS configuration. Most mobile telephones also allow text messages to be included in the MMS.
This option has the advantage of allowing the sender to include important clinical information, such as age, Glasgow Coma Scale (GCS), mode of injury, and other co-morbid problems. The 3gp clip was then transmitted as an MMS message over a variety of 3G networks run by various local mobile telephone service providers.

A total of 56 consecutive patients with acute neurosurgical problems requiring urgent after-hours consultation, who were admitted to a university hospital during a 6-month period, had their images recorded and transmitted using the above method. This was followed by a telephone discussion of the scan and the patients’ clinical condition between the admitting doctor and the neurosurgeon on-call, who was not on site.

All images were reviewed on a Nokia N95 Communicator™ by the senior author. The images were stored and reviewed on a later date by a second neurosurgeon on the same handset. Subsequently, an independent observer reviewed and scored the response to the diagnosis and the management plan by the two neurosurgeons. In addition, a radiologist reviewed the original images directly on the hospital’s Patient Archiving and Communication System (PACS) console and his diagnosis was compared with that of the first neurosurgeon and scored by the independent observer once again. All data were collected in a prospective manner.

**Results**

A total of 56 consecutive consultations were carried out in a 1-year period and involved a variety of problems that ranged from head trauma, spontaneous haemorrhages, and post operative complications (Table I).

Both neurosurgeons involved in this study were in complete agreement with the diagnosis in all 56 patients whose images were transmitted for consultations.

When the images transmitted over the mobile networks were compared with the original images on a standard radiological PAC viewer, the senior author and the radiologist were in agreement over the primary diagnosis in 55 of the 56 patients (98%), giving a kappa coefficient of 0.88, indicating almost perfect agreement.

The radiologist, however, did have the advantage of being able to vary the contrast and magnification on the PACs viewer, which allowed him to observe smaller changes. In the single consultation where there was a difference, the radiologist noted a sliver of an extradural haematoma that was only visible on a single slice of the CT scan. The diagnosis was only possible by varying the window settings on the console. However, these changes would not have affected our management plan for the patient concerned.

When the management decisions made by the neurosurgeons based on their diagnosis were carried out, there was a difference in management in six of the patients (11%). This gave a kappa coefficient of 0.77, suggesting a significant correlation between the two observers in their management plan based on the images transmitted. In all six patients, the diagnosis made was similar between both observers; therefore, we concluded that this difference was essentially due to professional differences in opinion on the management.

**Discussion**

The ideal neurosurgical consultation between doctors usually requires the visualisation of images in addition to clinical information, such as history and physical findings. Many hospitals do not have a resident neurosurgeon 24 h a day and initial management is initiated by residents or non-neurosurgeons, especially on weekends and after office hours. Moreover, it is also a problem if long-distance consultations are required and conventional image transfer technology is unavailable. In most instances, the scan images are described in words and their interpretation is left to the imagination of the doctor being consulted, leaving room for errors to occur.

This matter has been overcome with the use of the internet to transmit images of the cases being discussed. The use of the internet or telemedicine, however, has its limitation as both parties must have access to a computer and the necessary software that allow image transfer. This is also an expensive option because this method often involves licences that have to be bought and renewed yearly and place limits on the user numbers. Portability is an issue because any telemedicine network structure requires a dedicated console with a specific IP address to ensure secured connection and communication. Some hospitals allow members of staff to access images on their web browsers using mobile devices such as the iPad; however, once again, special software may be required.

Some authors have proposed the use of JPEG images sent on mobile telephones using MMS technology as a possible alternative for emergency consultations.4 This method is especially useful if only single images are required, such as in orthopaedic surgery.5,6 However, when CT or MRI images need to be sent, the presence of multiple images requires the physician to choose a single image that is most representative of the pathology. If more information is required, further images have to be sent. This adds time and is often inconvenient to the physician initiating the consultation who has to choose and send further images and to the surgeon being consulted who has to wait for these images for the consultation to progress.3

Transmitting medical data over mobile devices for consultation has been carried out in the transmission of ECG traces either between patients and their physicians,7,8 or between emergency services from an ambulance to the base hospital.9,10 Plastic surgeons have also used a similar technique to carry out video conferencing regarding soft tissue injuries and burns assessments.11–13

This study demonstrates that this method transmits images of sufficient quality to base emergency decisions
for patients with neurosurgical problems. Most images transmitted during an emergency are usually cases of haemorrhage or hydrocephalus, which are easily identifiable pathologies as they contrast quite significantly from the brain parenchyma.

The use of MPEG clips allows all images to be seen in one transmission. This is especially useful when additional information, such as mass effect and cisternal effacement, can be obtained. Additionally, the images can also be paused and magnified (within limits) to obtain a more accurate diagnosis.

In using this method of consultation, it is our opinion that the emergency neurological service has improved significantly because all images are now being reviewed by a consultant neurosurgeon irrespective of the location of the neurosurgeon or the time of day. The availability of visual images, in our opinion, improves the quality of our emergency communication compared to just a verbal account of the images available.

In our experience, if the required CT images involve both non-contrasted and contrasted images, it is best to send them as two separate messages.

This method, however, does have its drawbacks because one is unable to adjust the contrast of the images on the mobile telephone, which means that the sender has to ensure that the best settings for the images are selected before recording and transmitting the images.

Images also take time to transmit and this may range from 1 to about 15 min. We have found that during peak times of the MMS services, such as public holidays and when seasonal greetings are being sent over the system, this method of consultation may be delayed indefinitely, in which case, consultations will have to revert to conventional methods.

The use of the mobile telephone to transmit MPEG video clips of radiological images is very advantageous for carrying out emergency consultations in neurosurgery as the images transmitted accurately reflect the pathology in question.

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