Telemedicine in acute stroke
Remote video-examination compared to simple telephone consultation

Introduction

Use of telemedicine is rapidly growing in acute stroke care. Shortly after the first vision published by Levine and Gorman in 1999 [8], the first studies testing its feasibility were published [12]. Since then, the first experiences in routine use of telemedicine in acute stroke care have also been reported [7, 14]. Telemedicine has been demonstrated to be a safe and effective way to support administration of thrombolysis in smaller hospitals [1]. All these attempts used communication by telemedicine...
to perform clinical examination guided and evaluated by a remote examiner via real-time audio/visual communication mainly using videoconferencing systems. This method was found to be feasible and reliable when testing stroke patients and scoring established stroke scales [9, 12–14]. However, real-time video communication is fairly expensive as a high rate of data transmission is needed. Additional costs derive from the organizational impact as a clearly defined process and assistance at the bedside are needed [5]. Until now it has not been proven whether remote video-based examination is really mandatory to guide critical decisions in acute stroke care. Traditionally, in most hospitals a telephone call is used to establish communication with a remote specialist to obtain advice in individual cases. During such a call the treating physician would verbally provide all the data about the specific patient. In cases where a decision is impossible from the data reported, the specialist would have to see the patient personally, thus, requiring a transfer. We compare this traditional method of telecommunication to modern audiovisual linkage in acute stroke care in a prospective study.

Materials and methods

The study was conducted within the project “Stroke Care using Telemedicine in Northern Bavaria” (STENO), a small stroke care network consisting of 2 stroke centers in Nuremberg and Erlangen and 2 local hospitals (district hospitals at Roth and Forchheim, Bavaria, Germany). The STENO project was funded by the Bavarian Ministry of Labor and Social Welfare, Family and Women.

One stroke center is located in a university hospital and another in a large teaching hospital. Both hospitals run a stroke unit assigned by the state government according to national guidelines. Both have direct access to all methods of stroke therapy including neurosurgery or interventional neuroradiology.

The local hospitals are district hospitals responsible for primary and comprehensive care in the fields of general medicine and surgery as well as obstetrics and gynecology. In both hospitals the Departments of Internal Medicine are responsible for treatment of stroke. Each hospital has a stroke ward with 4 monitoring beds. Both hospitals run a stroke unit assigned by the state government according to national guidelines. Both have direct access to all methods of stroke therapy including neurosurgery or interventional neuroradiology.

Clinical examination was performed based on the National Institutes of Health Stroke Scale (NIHSS, German version) [4] by the remote examiner. The remote examiner directed the whole process, giving instructions to the patient and assistant via audio line. Assistance at the bedside was provided by the local physician or a trained nurse.

In one of the local hospitals, images of CT or MRI scans were reviewed by logging on to the Picture Archiving and Communication System (PACS, by TIANI Medgraph Co., Brunn, Austria). Using this technique no images were transferred but one could use all data within the local system without loss of quality. In the other hospital, the CT films were scanned by video using the closest zoom and highest resolution of the camera in a 90° angle (Fig. 2). The image review process was standardized for both methods.

In both local hospitals comprehensive training sessions were held on diagnosis and treatment of stroke and on use of the telemedicine system. Standard operating procedures were established on main aspects of acute stroke care and the process of teleconsultation. During one week, one of the two stroke centers was on duty for all teleconsultations in both local hospitals. In addition, using a week-to-week rotation there was a switch between pure telephone consultation (TC) for one week and full audiovisual consultation using remote video-examination (RVE) the next. As the rotations were cross-linked each stroke center was on duty for both methods of teleconsultation.

Remote video-examination of patients was performed using a novel audio-visual telesupport system (EVITA, Optics Research and Information Ltd, Erlangen, Germany), providing real time transmission of video/audio sequences from the local hospital to the stroke center. Details of the EVITA system and its technical features were previously reported [5].

To establish audio connection, a central room microphone and loudspeakers were used at the patient’s side in the local emergency room, and a headset at the examiner’s side at the stroke unit. For data transmission, a multiplex ISDN connection on the standard telephone network was used providing data speed up to 1500 kbps. Line management was established by ISDN routers; 15 lines were routinely connected for one teleconsultation.

Fig. 1 Telemedicine infrastructure at the local hospital. Remote controlled camera connected to the video server and PC. An X-ray viewer is located in a 90° angle to provide optimal view for CT scans.