CLINICAL RESEARCH

Videoconference pediatric and congenital cardiology consultations: a new application in telemedicine

Consultations de cardiologie pédiatrique et congénitale par vidéoconférence : une nouvelle application de la télémédecine

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SUMMARY

Background. — The relative rarity of congenital heart disease gives it an orphean disease status, requiring specialised centres. The present maturity of information technology allows telemedicine to be integrated into current medical practice. We report our experience of telemedicine between the cardiology department at St Pierre Hospital on the island of Réunion and the pediatric cardiology department at the teaching hospital in Toulouse.

Aims. — The aims of this work were to [1] verify the technical feasibility of transmitting echocardiographic images, [2] determine an optimal therapeutic strategy for each patient, and [3] deliver precise information live to patients and their families.

Methods. — Five pediatric cardiology videoconference consultation sessions were transmitted between April 2006 and May 2007. The videoconference equipment, POLYCOM VSX 7000 (R), was used to relay information between the two centres, using six high-debit digital telephone lines, allowing a transfer rate of 384 kbits/s and an image frequency of 25 frames per second. The echocardiographic equipment at St Pierre Hospital was connected to the videoconference equipment by an S-VHS video output. The transmitted sources alternated between the echographic video output and the signal from a video camera, with continuous audio transmission.

Results. — The telemedicine meeting was made up of three main elements: [1] a consultation with real-time echocardiographic acquisition and transmission, [2] a discussion between medical colleagues, and [3] a discussion with the family. Five videoconference consultation sessions were organised between April 2006 and May 2007. 22 patients were involved (median age 3 years, age range 7 days to 48 years). Heart disease was congenital in 20 patients, and acquired in 2 patients. The aim of the telemedicine consultation was to specify: [1] medical treatment in 7 patients, and [2] an indication for surgery or interventional catheterisation in 15 patients. There was no significant change in diagnosis, but in 2 patients with complex heart disease some anatomical clarifications were made. For 3 patients, the videoconference discussion was essential to get the extremely reticent families to accept the indication for surgery.

KEYWORDS

Telemedicine; Videoconference; Pediatric and congenital cardiology; Echocardiography.

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Methods

Population (table 1)

Five videoconferencing consultation sessions were organised between April 2006 and May 2007. 22 patients were involved (median age 3 years, age range 7 days to 48 years). Heart disease was congenital in 20 patients, and acquired in 2 patients. The aim of the telemedicine consultation was to specify: 1) medical treatment in 7 patients, and 2) an indication for surgery or interventional catheterisation in 15 patients. There was no significant change in diagnosis, but in 2 patients with complex heart disease some anatomical clarifications were made. For 3 patients, the videoconference discussion was essential to get the extremely reticent families to accept the indication for surgery.
Material

The videoconference equipment, POLYCOM VSX 7000 (R), was used to relay information between the two centres, using six high-debit digital telephone lines, allowing a transfer rate of 384 kbits/s and an image frequency of 25 frames per second. The transmitted sources alternated between the echographic video output and the signal from a video camera, with continuous audio transmission. The local operator could therefore be guided in real-time by the receivers regarding the choice of echocardiographic sections and the choice of Doppler modes. A technician locally was in charge of framing and zooming the video camera so that the patients could be examined by the specialists. The echocardiographic information was briefly reported on by the receiving centre team.

<table>
<thead>
<tr>
<th>N</th>
<th>Age</th>
<th>Heart Disease</th>
<th>Pathology</th>
<th>Therapeutic Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15 months</td>
<td>Hypokinetic dilated cardiomyopathy</td>
<td>Acquired</td>
<td>Medical</td>
</tr>
<tr>
<td>2</td>
<td>21 months</td>
<td>Right ventricular hypoplasia</td>
<td>Congenital</td>
<td>Surveillance</td>
</tr>
<tr>
<td>3</td>
<td>7 days</td>
<td>Left ventricular-right atrial fistula</td>
<td>Congenital</td>
<td>Interventional catheterisation</td>
</tr>
<tr>
<td>4</td>
<td>48 years</td>
<td>Partial atrioventricular canal, mitral leak</td>
<td>Congenital</td>
<td>Surgical</td>
</tr>
<tr>
<td>5</td>
<td>17 years</td>
<td>Interventricular communication with pulmonary artery hypertension</td>
<td>Congenital</td>
<td>Medical</td>
</tr>
<tr>
<td>6</td>
<td>9 years</td>
<td>Double discordance with interatrial communication and pulmonary stenosis</td>
<td>Congenital</td>
<td>Surveillance</td>
</tr>
<tr>
<td>7</td>
<td>11 years</td>
<td>Atrial flutter after surgery for congenital heart disease</td>
<td>Congenital</td>
<td>Medical</td>
</tr>
<tr>
<td>8</td>
<td>8 years</td>
<td>Hypertrophic cardiomyopathy with ventricular arrhythmia</td>
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<td>Medical</td>
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<tr>
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<td>47 years</td>
<td>Coarctation of the aorta</td>
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<td>Surgical</td>
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<td>10</td>
<td>15 days</td>
<td>Fallot’s tetralogy</td>
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<td>Surgical</td>
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<tr>
<td>11</td>
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<td>Ebstein’s anomaly with junctional tachycardia</td>
<td>Congenital</td>
<td>Medical</td>
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<td>12</td>
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<td>Interventricular communication</td>
<td>Congenital</td>
<td>Surgical</td>
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<tr>
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<td>Aortic supravalvular stenosis</td>
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<td>Surveillance</td>
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<td>Interventional catheterisation</td>
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<td>Congenital</td>
<td>Surgical</td>
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<td>Surgical</td>
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<td>17</td>
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<td>Left heart obstruction</td>
<td>Congenital</td>
<td>Interventional catheterisation</td>
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<td>20 months</td>
<td>Atrioventricular block</td>
<td>Congenital</td>
<td>Surveillance</td>
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<td>19</td>
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<td>Hypokinetic dilated cardiomyopathy</td>
<td>Acquired</td>
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<tr>
<td>20</td>
<td>20 months</td>
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<td>Surgical</td>
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<td>21</td>
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<td>Congenital</td>
<td>Surgical</td>
</tr>
<tr>
<td>22</td>
<td>1 month</td>
<td>Partial atrioventricular canal</td>
<td>Congenital</td>
<td>Surgical</td>
</tr>
</tbody>
</table>

Table 1 Therapeutic decisions according to clinical presentations.

Videoconferences

The telemedicine consultations consisted of four stages:
- before the consultation with the patient and family, the cardiological and pediatric team at the Saint Pierre Hospital in Réunion presented the case history;
- the second stage included the clinical examination of the patient, and echocardiography was performed with real-time image transmission;
- the third stage consisted of an interview with the patient, their parents and the pediatric cardiologists at the Toulouse teaching hospital;
Results

Feasibility of ultrasound transmission by telemedicine

It was possible to conduct the clinical consultation and echocardiography without sedation thanks to the reassuring presence of the parents during the videoconference. Nine out of the 22 patients were less than 2 years old. The quality of echocardiographic images received remotely (but checked locally thanks to the monitoring feature of the videoconferencing equipment) was considered satisfactory in all except 2 patients. For patient II (aged 21 months) the diagnosis of left ventricular communication with the right atrium could only be inferred due to poor resolution on the colour Doppler. Patient III at 7 days old was the youngest patient in the study; although the diagnosis of atrio-ventricular canal was made, a precise description of the atrio-ventricular valve could not be performed during this consultation.

Therapeutic decisions (table 1)

No diagnoses were corrected, but in two patients with complex heart disease some anatomical clarifications were made (patients IV and VI). In 7 patients, medical treatment was discussed: 4 had rhythm disorders (patients VII, VIII, XI) or a conduction defect (patient XVIII), 2 had hypokinetic dilated cardiomyopathy (patients I, XIX) and one had Eisenmenger’s syndrome with interventricular communication (patient V). In 15 patients, a surgical procedure or interventional catheterisation was discussed between with the families. In 3 patients who required surgical management, the videoconference was essential to get the extremely reticent family to accept the therapeutic indication.

Videoconference costs

The cost of videoconferencing is made up of the material costs and the price of the telephonic communication. The hospitals in Toulouse and St Pierre already possessed the necessary material and no additional investment was necessary to perform the videoconferences. The cost of telephonic communication was assumed by St Pierre Hospital in Reunion, from its budget set aside for telemedicine. The average duration of the videoconference consultations was 1h30. The hourly rate for a line is 12.211 € before tax. The hourly rate for a debit of 384 kb/s (six 64 kb/s digital lines) was therefore 12.211 x 6 = 73.266 € before tax.

Discussion

This is the first time that telemedicine has been applied to pediatric and congenital cardiology consultations in France. The excellent transmission quality of echocardiographic images and the possibility of live discussions with the families are the two major advantages of these videoconferences that took place between the hospitals in St Pierre in Réunion and Toulouse.

Telemedicine and technology

Telemedicine involves remote communication, using a suitable infrastructure, of a range of clinical elements and additional investigations, with the aim of establishing a diagnosis, deciding on treatment, or performing follow-up, without the need for the patient to travel far. In 1950, Gershon-Cohen et al reported their experience of telognosis (a neologism combining the words teleo, Roentgen and diagnosis) thus demonstrating the possibility of transmission of radiological images by telephone or radio [3]. The first interactive video link between two hospitals 112 miles apart was made in 1964 [2]. The telemedicine systems in use today originated from NASA’s manned space flight programme, for which communication systems were developed to monitor astronauts’ physiological parameters and commence in-flight treatment for certain emergency situations. The first reported uses in cardiology date from 1989 with the transmission of pediatric cardiology images by telephone [6]. Similar experiences were described in 1993 with the transmission of routine adult echocardiographic images and stress echography studies [7-9]. The first live digital transmissions were reported in 1996 [10]. In France in 2003, the experience of medical meetings and live transmission of coronary angiography images between hospitals in Rodez and Toulouse was reported [11].

Telemedicine and geography

The application of remote pediatric cardiology is linked to the geographical separation between the transmitting hospital and the receiving referral centre. Teams in Canada have reported their experience of videoconferencing between extremely isolated sites and a referral centre, which allowed diagnoses to be established, suitable treatment to be immediately instigated, and decisions to be taken on transferring patients [1, 12]. The cardiology department at the hospital in Saint Pierre in Réunion is the only cardiological service in the south of the island, serving approximately half of the island’s population of 750,000 inhabitants. Communicating the cardiological case notes is a necessity and relies on various means of communication, such as telephone, posting video cassettes or emailing scanned ECG images. With all of these techniques it is impossible to transmit real-time echocardiography data or give information live to patients and their families. Thanks to the quality inherent in a digital link and the absence of any perceptible time-delay, telemedicine has opened the way for videoconference consultations and allows interactive discussion between the participants. This has benefits for both the remote hospital and the receiving university departments. Telemedicine is recognised by the governing health authorities in France as an integral part of providing healthcare. The St Pierre Hospital in Réunion even has a budget set aside for videoconferencing. Several studies have demonstrated that the savings in terms of avoiding transport outweigh the investment necessary for the equipment and the cost of telephone charges [2,4].
Conclusion

Congenital and pediatric cardiology videoconference consultations allow two distant centres to respond to healthcare needs (taking therapeutic decisions and providing information for families), avoiding often long and expensive journeys. They also allow remote medical teams to exchange medical information in a convivial manner and respond to the needs of continuing education, which are essential in medicine, particularly in a field as specialised as pediatric and congenital cardiology.

References