Telecardiology Partnership with Marrakech, Morocco: Supporting Pediatric Cardiology in the Developing World

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Congenital Heart Disease
Developing World

- 1% of children
- Often amenable to single intervention
- 6 million children waiting
- Without treatment many die young
- Ongoing treatment of unrepaired children expensive; impacts extended family/community
- Years of life saved/dollars spent compares favorably to vaccine/nutrition programs
Rheumatic Heart Disease

- Most common acquired heart disease in the world
- Endemic in Sub-Saharan Africa
- 16 – 60 million people affected: majority are children
- 500,000 new cases per year
- 250,000 deaths per year
- 20% maternal mortality
- PREVENTABLE
Open Heart Surgery
Global Availability

Unger F. Worldwide survey on cardiac interventions. Cor Europaeum. 1999
Blueprint

• Premise: no child amenable to single stage life altering cardiac intervention should be denied care

• Support/build local cardiovascular program
  – Visiting teams
  – Continued training of medical staff
  – Technology expansion
  – Consortium building
  – Research collaboration
  – Independence and sustainability

• Telemedicine has potential to play key role
Morocco Telemedicine

• Distance education: Rabat Children’s Hospital
  – Diabetes
  – Gastroenterology
  – Nutrition

• Cardiology/cardiac surgery collaboration: Marrakech
  – Mohammad VI University Hospital
  – Hospital Ibn Tofail
Supporters

• Supported by grant from Mosaic Foundation: Arab Ambassadors Wives – $800,000
  – Built telemedicine infrastructure
  – Travel to Morocco
  – Host Moroccan medical team in Washington

• Satellite dish and service
  – Intelsat: Bandwidth for satellite service
  – IDirect: Satellite dishes

• Telemedicine equipment
  – VitelNet
  – CISCO/Tandberg

• Moroccan Ambassadors to US
• US Embassy in Morocco
Marrakech Telecardiology

- Help to build sustainable cardiac surgery program
- Education exchange on the ground
- Weekly live case discussions with cardiac surgeons and cardiologists
- Meet with Moroccan and US government officials
Marrakech Telecardiology

Goals

- **Infrastructure development/installation**
- **Clinical education**
  - Echocardiography
  - Cardiovascular surgery
    - Case selection
    - Surgical techniques
  - Cardiac Catheterization
- **Nursing**
- **Biomedical engineering**

- **Modalities**
  - Hands on/Marrakech
  - Observation/Washington
  - Live telemedicine
    - Case discussion
    - Lectures
  - Content server
    - Case review
    - Stored education content

English/French

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Marrakech Telecardiology History

- 9 visits to Marrakech: 2005 – Present
- 2 cardiac surgery visits: 8 surgeries in 2011
- Cardiac catheterization visit: June 2013
- Videoconferencing started in 2009
- 2 visits by Marrakech team to Washington
  - Intensive care
  - Echocardiography
  - Cardiac surgery
  - Nursing
  - Anesthesia
  - Perfusion
Marrakech Telecardiology Videoconference Protocol

- Scheduled via email usually 10 AM/3 PM
- Set up automatically via multipoint conference unit
- Video over IP: 256 – 384 KBPS
- Flexibility on DC end
  - Conference room
  - Office/home desktop
  - PC/IPAD CISCO Jabber
Marrakech Telecardiology Results: 2011 – 2012

• 59 conferences
  – Some scheduling challenges
  – No technical difficulties cancelled conferences

• 170 cases/139 patients
  – Mean age 4.8 years
    • 3 days to 30 years
    • 44 < 2 years
  – Mean oxygen saturation 83% - 39 patients < 80%

• Echocardiography
  – Additional images in 39 patients
  – Considerable improvement in skills
Marrakech Telecardiology Results: 2011 – 2012

- Tetralogy of Fallot: 26
- Single Ventricle: 17
- Double Outlet Right Ventricle: 17
- Atrioventricular Septal Defect: 13
- Ventricular Septal Defect: 12
- Transposition: 12

[Graph showing the number of cases for each category]
Marrakech Telecardiology
Results: 2011 – 2012

• 25% of patients discussed had surgery
• ½ of the patients undergoing surgery had change in plan
• 3 operations performed for first time in infants
  – Tetralogy of Fallot
  – AV canal defect
  – D-Transposition
Marrakech Telecardiology
Asynchronous Applications

• **Uploading of echocardiograms**
  - Email
  - Dropbox
  - Cloud server

• **Educational content – Content Server**
  - Lectures
  - “Live” PDF files
  - Translation into French
Tetralogy of Fallot

Anatomy

Consists of 4 components

- Ventricular septal defect – anterior malalignment type usually with membranous extension, occasionally there are associated muscular VSDs
- Right ventricular outflow tract (RVOT) obstruction – the extent of obstruction varies, may be just infundibular stenosis, may also involve the annulus and the valve leaflets, the outflow tract may even be atretic
- overriding of the aorta
- Right ventricular hypertrophy

Often the branch pulmonary arteries are smaller in size or show areas of narrowing and obstruction

Echo – Aorta overriding large VSD

Echo – RVOT and Valve with turbulence

Echo – RVOT

Cath – RVOT still frame

La Tétralogie de Fallot

L’Anatomie

Se compose de

- Une CIV – un type antérieur malin généralement avec l’extension membraneuse, d’occasion il y a des CIV musculaires associées.
- L’obstruction de la voie pulmonaire de la ventricle droite (VPVD), l’étendue varie, il peut être qu’une sténose pulmonaire infundibulaire, ou peut aussi impliquer l’anneau et les feuilles valvulaires, le VP pourrait être atrésique.
- Un chevauchement aortique
- Une hypertrophie ventriculaire droite

Les artères pulmonaires branchées sont plus petites en taille ou montrent des domaines de rétrécissement et obstruction.

Écho – L’aorte outrepasse une grande CIV

Écho – VPVD et une valve avec du turbulence

Écho – VPVD

Cath – VPVD Cadre-fixe
Barriers

- Technology
- Bandwidth
- Satellite time
- Time zone
- Language
- Funding
Conclusions

• Telemedicine is a feasible and effective means of building a clinical and educational collaboration
• Telemedicine can augment the diagnostic and surgical skills of a cardiovascular surgery team in an emerging nation
• Sustainability is based on dedication of personnel, reliable technology, consistent bandwidth and ongoing funding