The HUB Spoke system in emergency health situation

Prof. G. Gerosa
Department of Cardiac, Thoracic, Vascular Science
University of Padua, Italy
Cardiogenic shock is a major, and frequently fatal, complication of a variety of acute and chronic disorders that impair the ability of the heart to maintain adequate tissue perfusion.

Cardiogenic shock is a physiologic state in which inadequate tissue perfusion results from cardiac dysfunction, most commonly following acute myocardial infarction (MI).

Although ST- elevation MI (STEMI, previously termed Q-wave MI) is encountered in most pts, cardiogenic shock may also develop in pts with non–ST- elevation ACS (NSTEMI or unstable angina).

Cardiac failure with cardiogenic shock continues to be a frustrating clinical problem.

The management of this condition requires a rapid and well-organized approach.

Sat Sharma, MD, FRCPC, Professor and Head, Division of Pulmonary Medicine, Dpt of Internal Medicine, University of Manitoba; Site Director, Respiratory Medicine
Percutaneous left ventricular assist devices in acute myocardial infarction complicated by cardiogenic shock

Holger Thiele1*, Richard W. Smalling2, and Gerhard C. Schuler1

Figure 1 Possible scheme for selection of patients with cardiogenic shock complicating acute myocardial infarction for implantation of left ventricular assist devices (not supported by randomized controlled trials).
RATIONALE FOR ASSIST DEVICE

- Prevention of death and/or multiorgan deterioration secondary to low perfusion

- Assist devices should be considered when clinical conditions suggest an impending and irreversible risk of death and organ transplantation
GOALS

- Immediate rescue
- Bridge to decision
- Short-term bridge to recovery
- Bridge to implant of a mid or long-term extracorporeal or intracorporeal MCAD
ASSIST DEVICE SUPPORT

- Therapeutical Goal
- Positioning
- Endurance
- Type of flow
- Concomitant therapy
- Complications
THE “HUB AND SPOKE” SYSTEM
The “hub and spoke” concept explained

The “hub and spoke” model typically involves arrangements whereby one site acts as a principal base proving centralised support or activates to satellite sites which are connected to the principal site.

As a metaphor, the image is of a wheel with a core component (the hub) and many sub-components (the spokes).

Together, the hub and spokes form a whole that can progress forward as one unit.
What is a “hub and spoke” service delivery model health care?

“Hub and Spoke” arrangements can vary within the healthcare sector depending on the nature of the organization involved and the types of services being provided.
What are the parameters?

• There will be a lead organization as the funding recipient
• There will be an identified principal site and identified satellite sites
• The principal site and satellite sites will be located within the local community
• The “hub and spoke” will have shared organisational and clinical governance
• There will be common branding
• There will be shared information management and information technology system
What is the virtual service delivery model in health care?

A virtual service delivery model involves arrangements whereby individuals and/or individual practices operate in a network to provide specific service and/or functions from separate sites within a community but communicate and work collaboratively with each other through common integrated information technology and information management system.
Regional Referral System for Patients with Acute Mechanical Support: Experience at The Cleveland Clinic Foundation

Gonzalo V. Gonzalez-Stawinski,* Albert S. Y. Chang,* Jose L. Navia,* Michael K. Banbury,* Tiffany Buda,* Kathy Hoercher,* Randall C. Starling,† David O. Taylor,† and Nicholas G. Smedira*

The purpose of regional referral networks is to provide large geographic areas with rapid access to expensive, resource-intensive, specialized care. This has been particularly effective in trauma and neonatal intensive care programs. Mechanical circulatory support has recently utilized this concept, and the majority of hospitals provide short-term resuscitation and support. For optimal outcomes, these hospitals must be affiliated with centers who are experienced in short-term and long-term mechanical circulatory support along with transplantation. Because not all cardiogenic shock patients will gain benefit from this strategy, it is important that the overall system understand factors associated with success.

ASAIO Journal 2006
Between January 1995 and September 2003, 39 patients were received in transfer for continued care after the implantation of a cardiac assist device. Eighty-five percent of patients had the ABIOMED BVS 5000 implanted. The most common indication was postcardiotomy shock. Sixty-four percent of patients were not candidates for heart transplantation due to medical or social contraindications. The 30-day mortality of this group was 62%.
Figure 1. Outcomes after admission to hub facility. Out of 39 patients transferred for continuous management of a ventricular assist device, 15 (38%) survived. Among the 15 survivors, 7 patients were successfully weaned from the device and 8 were converted to long-term devices. Six of these survivors were subsequently transplanted. Nonsurvivors were rarely weaned from their devices. LTD, patient converted to a long-term device; HTX, heart transplant; LTS, patient placed on long-term-support.
A Multidisciplinary Network To Save the Lives of Severe, Persistent Cardiogenic Shock Patients

Aly El-Banayosy, MD, Dagmar Cobaugh, MD, Armin Zittermann, PhD, Lukasz Kitzner, MD, Latif Arusoglu, MD, Michiel Morshuis, MD, Hendrik Milting, PhD, Gero Tenderich, MD, and Reiner Koerfer, MD

Department of Cardiothoracic Surgery, Heart Center North-Rhine Westfalia, Ruhr University of Bochum, Bad Oeynhausen, Germany

---

**Fig 1. Management protocol for severe, persistent cardiogenic shock patients.** (IABP = intra-aortic balloon pump; VAD = ventricular assist device.)
Follow-up
N=50

Emergency VAD Therapy
N=6

Optimal Medical Treatment
N=44

In summary, early as well as late medical results emphasize the multidisciplinary and network approach to improve the outcome of cardiogenic shock patients. In future studies, further improvements of medical treatment as well as the optimal time span between admission and implantation of VADs should be evaluated. Moreover, the optimal VAD systems, including system-related survival, and quality of life has to be assessed.
Left Ventricular Assist Device Bridge-to-Transplant Network Improves Survival After Failed Cardiotomy

David N. Helman, MD, David L. S. Morales, MD, Niloo M. Edwards, MD, Donna M. Mancini, MD, Jonathan M. Chen, MD, Eric A. Rose, MD, and Mehmet C. Oz, MD

Overall Survival to Hospital Discharge = 66%
TCI LVAD Survival to Hospital Discharge = 74%

**Fig 2.** Disposition of patients referred to postcardiotomy left ventricular assist device (LVAD) network. (TCI = Thermo Cardiosystems, Inc.)
The postcardiotomy network concept was based on the realization that many cardiac surgical centers have the capability of implementing short-term cardiac assist devices but do not have long-term ventricular assist or heart transplantation programs in place. 

The rate of long-term survival. Discussions between surgeons at our hub center and the spoke hospitals initially covered the adequacy of temporary mechanical support that had been instituted and the status of end-organ function.

The results of this screening step established the status of patient resuscitation and dictated the urgency of subsequent transfer to our institution.
Once the decision to transfer the patient to the hub had been finalized, we attempted to achieve this within 72 hours of the initial surgical procedure to reduce the chance of sepsis and to avoid the usual multiple organ system failure which eventually occurs in this sick patient population.

An important branch point in our management algorithm was based on our assessment of the potential recovery of the heart.

Improved Survival After Acute Myocardial Infarction Complicated by Cardiogenic Shock With Circulatory Support and Transplantation: Comparing Aggressive Intervention With Conservative Treatment

Wakkas Tayara, MD, a Randall C. Starling, MD, MPH, b Mohamad H. Yamani, MD, b Oussama Wazni, MD, b Fuad Jubran, MD, b and Nicholas Smedira, MD c

We retrospectively analyzed the clinical outcome of 138 consecutive patients at the Cleveland Clinic from 1992 to 1998 who met the criteria for cardiogenic shock after acute myocardial infarction. All patients received intensive medical therapy and intra-aortic balloon pump support. Forty-three patients received intensive medical therapy (conservative group) and 95 patients were treated aggressively (aggressive group). The aggressive group comprised patients who were treated with percutaneous intervention/coronary artery bypass grafting (n = 77, re-vascularization group), and patients who received circulatory support/cardiac transplantation (n = 18).
In conclusion, these data suggest that, in a small percentage of patients, an aggressive intervention strategy, specifically LVAD support as bridge to cardiac transplantation, may improve survival in patients with cardiogenic shock.

Figure 3. Kaplan–Meier 5-year survival for the aggressive sub-groups of patients.
Aim of the project is to validate the “hub and spoke” network in the VAD-based therapy of acute cardiogenic shock in a regional setting.
STUDY POPULATION

- All patients aged between 18 and 70 years, suffering from acute cardiogenic shock due to both myocarditis and IMA

- Patients must be hospitalized in the Acute Cardiac Care Units of the participating centers (spoke)

- Patients will be included in the study upon request of the referring Cardiologist, once inclusion criteria are verified

- The indication to VAD therapy will be evaluated and finally confirmed by the cardiac surgeons of the coordinating Center (hub)
ENDPOINTS

Primary

“hub and spoke” network validation survival of mechanically assisted patients

Secondary

incidence of myocardial recovery number of conversion to major devices incidence of device and procedure-related complications
Expected advantages for the spoke

- to grant “state of the art” for complex acute heart failure therapy to their patients
- to implement sharing of scientific knowledge with the hub
- to implement programs for local implantation of “first stage” mechanical devices, under the supervision of the hub
- to readmit treated patients from the hub for local follow-up and care

Expected advantages for the hub

- to maintain an adequate volume of cases to implement internal expertise
- to trace new therapeutical strategies and implement new working protocols to identify new timing to procedures, selection criteria, predictors of outcome, and device selection criteria
HELIPORTED ECMO FOR CARDIOGENIC SHOCK EXPANDS CARDIAC ASSIST SURGICAL PROGRAMS

Objectives
ECMO is an effective technique to provide emergency mechanical circulatory assistance for patients with cardiogenic shock refractory to conventional medical therapies.
For patients with hemodynamic instability outside our institution we create a Heliported Remote Cardiac Assist unit to implant the ECMO and bring them back when stabilized in our ICU for follow-up.
Our study was undertaken to evaluate the feasibility of the procedure and the results of our experience.

Methods
Between March 2006 and June 2008 38 consecutive pts in acute cardiogenic shock were implanted with percutaneous ECMO by our heliported team.
We analyzed logistic concerns, indications, complications, and outcomes of these patients.
Results
There were no logistic or technical problems during round trip or ECMO implantation
**Mean distance from our ICU was 42 miles (1-143)**
**Maximal time limit between phone call and implantation was 90 min**
Mean LVEF evaluated by TTE was 19 ± 5%
**Indications**: fulminant myocarditis, pharmacologic suicide attempt, AMI, post-partum cardiopathy, end-stage DCM. They received a percutaneous VA femoral ECMO with immediate reperfusion of the limb
**17 pts (45%) were successfully weaned from ECMO after 9.4 ± 8.7 dys**
4 pts (11%) were transplanted
1 pt (3%) was switched to a LVAD and successfully transplanted
**21 pts (55%) survived to hospital discharge**

Conclusions
The Heliported Cardiac Remote Assist unit allowed the emergent implant of ECMO support without logistic or technical problems and could rescue 55% of otherwise lethal cardiogenic shock patients in remote institutions or institutions without cardiac surgery department
**HUB AND SPOKE – Greater PD area**

**Conferma diagnosi di Shock Cardiogeno**

- Posizionare Swan-Ganz
- Ecocardiografia
- Monitorare diuresi

**Shock?**

NO → **STOP**

SI →

- Stabilizzazione paziente
- Uso di inotropi
- Impianto IABP

**Paziente stabile?**

NO →

SI →

- Diuresi conservata
- Limitato supporto inotropo

**Osservazione**

**2 o più inotropi + IABP**

Score di $O_2$

IABP Score

**Criteri di esclusione?**

ASSENTI → **STOP**

PRESENTI

**Paziente trasferibile?**

SI →

NO →

- Contattare HUB

**SUPPORTO**

**SPOKE ⇌ HUB**
VAD for circulatory support in cardiogenic shock

Medical Challenge

“.. even an experienced and skilled team will have to face the medical challenge to match the right technology to the right patients at the right time .., thereby maximizing the chance of a successful outcome”

Emergency in cardiovascular surgery: an integrated approach

Prof. G. Gerosa
Department of Cardiac, Thoracic, Vascular Science
University of Padua, Italy