THE RF APPROACH TO TREATING MITRAL REGURGITATION. THE QUARTUMCOR SYSTEM

RICHARD R. HEUSER, MD, FACC, FACP, FESC, FASCI Director Of Cardiology, St. Luke's Medical Center, Phoenix, Arizona Clinical Professor of Medicine Univ. of Arizona, College of Medicine, Tucson, Arizona

Presenter Disclosure Information

Name: RICHARD R. HEUSER M.D.

Within the past 12 months, the presenter or their spouse/partner have had a financial interest/arrangement or affiliation with the organization listed below.

<u>Company Name</u> QuantumCor Kensey Nash CSI <u>Relationship</u> Major Stock Holder/Medical Director Honorarium Stockholder

<u>**Patents</u></u> -- RF, Snares, Wires, Balloon Catheters, Covered Stents, Devices for Arterial Venous Connection, Devices for LV and RV Closure</u>**







Background

• Ischemic Mitral Regurgitation (MR) Is A Common Problem Occurring In 45-74% Of All Myocardial Infarctions And Results In Harmful Ventricular Remodeling and Increased Morbidity And Mortality.



Percutaneous Treatments for Mitral Regurgitation

Percutaneous Treatment for <u>Ischemic</u> Mitral Regurgitation is not new...



Coronary Angioplasty for Acute Mitral Regurgitation Due to Myocardial Infarction

A Nonsurgical Treatment Preserving Mitral Valve Integrity

RICHARD R. HEUSER, M.D.; GERRY L. MADDOUX, M.D.; JEROME E. GOSS, M.D.; BARRY W. RAMO, M.D.; GILBERT L. RAFF, M.D.; and NEAL SHADOFF, M.D.; Albuquerque, New Mexico

Annals of Internal Medicine. 1987;107:852-855.



Percutaneous Mitral E2E Repair













Event Free Clinical Success Kaplan-Meier Patients with Acute Procedural Success n = 68







Evalve Results

- 100 Patients on Front end...18% out at end...eligible for enrollment
- 159 enrolled...135 receive clip
- Success rate 83%
- Discharged home 98%



Usually Addressed with Mitral Annuloplasty Rings





Reduce posterior annular circumference Push posterior leaflet forward for better coaptation





Coronary Sinus Dilates in Mitral Regurgitation 491 GC AIV MAR 7F RA CS

Fig. 1. CS venography taken in the left anterior oblique 30° view demonstrates the close relationship between the CS and the mitral annulus. The CS encircles the mitral annulus. The GCV empties into the CS and then into the RA. AIV, anterior interventricular vein; CS, coronary sinus; GCV, great cardiac vein; MAR, mitral annuloplasty ring; RA, right atrium; LPV, left posterior vein; and 7F C = 7 french catheter.

Catheterization and Cardiovascular Interventions 67:490-494 (2006)



Coronary Sinus Anatomy For the Venture Capitalist

Coronary sinus allows percutaneous mitral repair







Coronary Sinus Anatomy For The Clinician



Coronary Artery Between IV Vein or CS and Mitral Annulus In 16.4% and 63.9%

} Mean Distance 9.7 +/- 3.2 mm

Maselli, et.al., Circulation, August, 2006



Percutaneous Treatments for Mitral Regurgitation

Problems with coronary sinus approach

- Anatomic variability is great
- Muscle stretch may occur over time losing the desire effect over time
- Potential for compromise of the circumflex coronary artery as it passes beneath the coronary sinus
- Long term effect of a device in the coronary sinus not known (probably not a problem)







AJGC. 2006;15:291-301.







Why Pursue Percutaneous Devices in FMR

- Devices Do Work To Some Degree In Some Patients
- Only A Miniscule Percentage Of The 400,000 Patients With HF And FMR Are Currently Referred For Surgery
- These Are Still First Generation Devices
- There Is A Whole Lot Of Money And A Lot Of Smart People Working On This



Background

Mitral Annulus Slices

(Trichrome Stain)







Left, Posterior Leaflet Segment *Middle, Posterior Leaflet Segment* *Right, Posterior Leaflet Segment*





QUANTUMCOR

The QuantumCor[™] Device Uses Radiofrequency (RF) Energy At Subablative Temperatures To Produce Contraction Of The Mitral Valve Annulus And Theoretically Reduces Mitral Regurgitation.



Method



Method

Boa-Surg

- 7 Electrodes/14 Thermocouples
- 3mm Length
- 2mm Spacing
- 40mm Loop Diameter





Method

Acute Animal Procedure

- Intra-cardiac Ultrasound (ICE) Preprocedure.
- Left Thoracotomy-on Pump.
- Access Through The Atrial Appendage.
- Sutures In 4 Regions Of The Annulus As Markers (1-2cm).



Method Mitral Annulus Treatment Sites



Mitral Annulus Treatment Sites



RESULTS Mitral Annulus Treatment Sites



RESULTS



June 27, 2006 Mitral Valve Pre-treatment S-L Diameter 28.7 mm



Sheep # 10 Mitral Valve Post-treatment S-L Diameter 20.3 mm







RESULTS

Acute Histopathology Results

"Acute Radiofrequency Treatment Of The Mitral Annulus With The QuantumCor Probe Produced Well-demarcated And Discrete Areas Of Subendocardial Myofibrin Necrosis With No Or Little Appreciable Acute Structural Effect Microscopically To The Collageous Framework."


Acute Histopathology Results

No damage to the valve leaflets.
No damage to the coronary sinus.
No damage to the coronary arteries.



BOA-SURG Probe





Acute Success in All Animals





R. Heuser



Chronic Animal Series S-L Shrinkage Durability



R. Heuser









Chronic Histopathology Results

• The healing process was shown to be mature and complete at the 90 observation period. There were no apparent adverse changes caused by the thermal treatment at 90 or 180 days.



Chronic Histopathology Results

- When extramural coronary arteries were present in the tissue, they were not involved in the lesion and were microscopically normal.
- Most sites at 180 days showed no appreciable microscopic changes.



Chronic Histopathology Results

No damage to the valve leaflets.
No damage to the coronary sinus.
No damage to the coronary arteries.





Chronic Animal Series S-L Shrinkage Durability

More Than a Leap of Faith



Human Heart Project



Histological Comparison of MV Annulus <u>Human vs. Ovine</u>

- Tissues Stained with Hematoxylin & Eosin(H & E) and Masson's Trichrome.
- Annulus of mitral valve of both species consisted of a sheet of closely packed connective tissue fibers.
- Connective tissue of Ovine have the appearance of small closely packed bundles.
- Connective tissue of human have the appearance of tissue arranged as a sheet or of very large bundles.

Conclusion:

- Overall structure of the mitral valve annulus of human and Ovine sections are <u>comparable</u>.
- Both the annular segment and histology studies validate that the human results should be similar to what was seen in the Chronic Ovine series.



Histological Comparison of Mitral Valve Annulus: Human VS Ovine

Human Mitral Annulus X-section Sheep Mitral Annulus X-section



Annulus Linear Shrinkage

Porcine (In situ), Human (In situ) and Ovine (In vivo)



BOA-SURG Probe



















BOA-SURG Probe













The RF Approach to Treating Mitral Regurgitation: The QuantumCor System

A Repeatable Less Invasive Option May Be Desirable.



The Best Possible Application

to the Less Invasive Approach

for Mitral Regurgitation...



FUNCTIONAL MR



ISCHEMIC MR



EXTREMELY REDUCED

LV FUNCTION


MODERATE MR



Background



Percutaneous Mitral Valve Repair

• Obvious Strategy for PMVR is to combine direct valvular procedure with a percutaneous annuloplasty technique

• Mimics what is done surgically



RESULTS

Percutaneous Treatment for Mitral Regurgitation **TOO EARLY TO TELL**

- With RF Energy Applied To The Mitral Annulus It May Be Possible To Treat A Larger Population Of Patients With Mitral Regurgitation.
- If You Don't Succeed You Can Repeat The Procedure.
- Treat Without Affecting The Coronary Sinus.
- Use In Conjunction With Leaflet Procedures.









CONCLUSIONS

The QuantumCor Device May Offer An Option Some Patients With Mitral Regurgitation:

1st In The Operating Room.

Eventually As A Percutaneous Treatment For Mitral Regurgitation That Could Be Performed With Standard EP RF Consol In The Catheterization Laboratory.















Boomerang





Angio-Seal



EuroIntervention

Surgical isolated edge-to-edge mitral valve repair without annuloplasty: clinical proof of the principle for an endovascular approach

Francesco Maisano*, MD; Giorgio Viganò, MD; Andrea Blasio, MD; Antonio Colombo, MD; Chiara Calabrese, Ottavio Alfieri, MD

San Raffaele University Hospital, Milano, Italy

EuroInterv.2006;2:181-186

- 181 -



Surgical Isolated Edge-to-edge Mitral Repair Without Annuloplasty



Clinical Proof Of Principle For An Endovascular Approach

Maisano F, Vigano G, Blasio A, Columbo A, Calabrese C, Alfieri O,

Eurointervention 2:181-186, 2006





Endovascular Today October 2006







Evalve Results

- Freedom from MACE 30 days 95%
- Partial clip detachment 8.7%
- 73% surgery free at follow-up
- ~ 50 patients randomized most have 1+ or less of MR





Human Heart Project

• Bench-top treatment comparison between normal:

- > Human mitral valve annulus, in situ
- > Porcine mitral valve annulus, in situ
- > Ovine mitral valve annulus, in vivo
- > Ovine mitral valve annulus, in situ (not complete)

Objective: Evaluate in situ thermal shrinkage in human annular tissue as compared to Porcine

- Histological comparison of annular collagen in;
 - Human normal
 - > Human with MR
 - > Ovine normal

Objective: Evaluate human annular collagen as compared to Ovine collagen



Results

- All tissue segments treated the same: RF generated heat, 65 ° C, 50 W for 60 Seconds.
- Several human segments intermittently calcified probably affecting the shrinkage response.
- In-situ porcine and human segments response similar, 8.9 and 8.5 %, respectfully
- Ovine response greater, 11.8 % expected-live viable tissue.
- On-going study-Ovine in situ and MR human hearts in situ to be evaluated next.

