Intraoperative Transesophageal Echocardiography

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Rochester, Minnesota
IOTEE

1. How many work in the operating room?

2. How many are familiar with IOTEE?

3. Impact of IOTEE?
   A. 10%
   B. 30%
   C. 50%
   D. 80%
   E. No proven benefit
IOTEE

Pre bypass
• Confirm Diagnosis
• Any new findings
• Change surgical plan?

Post bypass
• Confirm Surgical result
• Any new findings
• Go back on bypass?

A Safety Net
IOTEE Overview

- Review of Echocardiography Background/history
- TEE imaging
- Contraindications
- OR routine
- Indications
- Experience
- Impact
- What we miss
- Usual and unusual cases
IOTEE
Origins of Ultrasound
Origins of Ultrasound

1937 - Sokolov first patent on ultrasound

1950s – Wild & Reid US of heart – autopsy

1954 – Edler and Hertz

*Edler I, Hertz CH. Use of ultrasonic reflectoscope for the continuous recording of movements of heart walls. Kungl Fysiogr Sallsk Lund Forh.. 1954;24:40*
Origins of Ultrasound

1954 – Edler and Hert  Next 22 years

A Mode

B Mode

M Mode
Origins of Ultrasound

2D /3D Echo
Origins of Ultrasound

Denier's ultrasonic apparatus in 1946
Origins of Ultrasound

Transthoracic Echo
Origins of Ultrasound
IOTEE

Introduced clinically to U.S. in 1980s

High resolution images

Easy to perform

Portable

Immediate feedback
IOTEE

Freeman - IOTEE

Oh - Echo Manual
TEE
Absolute Contraindications

• Esophageal obstruction
  Stricture, neoplasm

• Esophageal diverticulum

• Esophageal perforation
  Fistula, laceration
IOTEE

Overview

✓ Review of Echocardiography Background/history
✓ TEE imaging
✓ Contraindications
  • OR routine
  • Indications
  • Experience
  • Impact
  • What we miss
  • Unusual and unusual cases
IOTEE
IOTEE Procedure

• Cases usually requested by surgeon
• IOTEE equipment placed in OR room and setup by OR techs
• Probe placed by anesthesia after sedation, intubation and lines
• Prebypass IOTEE performed and recorded
• Results discussed with surgical team
• Operation
• Postbypass IOTEE performed
• Results discussed with surgical team
• IOTEE equipment removed from OR room by OR techs
• TEE probe cleaned, report completed
25 year Mayo IOTEE Experience
Percentage Pump Cases with IOTEE

- **Cases:**
  - 1991: 50%
  - 1992: 31%
  - 1993: 50%
  - 1994: 2%
  - 1995: 72%
  - 1996: 72%
  - 1997: 72%
  - 1998: 72%
  - 1999: 72%
  - 2000: 72%
  - 2001: 72%
  - 2002: 72%
  - 2003: 72%
  - 2004: 72%
  - 2016: 94%
IOTEE Overview

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  - Unusual and unusual cases
A forceful contact: the force of impression of one thing on another: a significant or major effect, the impact of science on our society.
IOTEE

Pre bypass

• Confirm Diagnosis
• Any new findings
• Change surgical plan?

Post bypass

• Confirm Surgical result
• Any new findings
• Go back on bypass?

A Safety Net
Intraoperative Transesophageal Echocardiography: 5-Year Prospective Review of Impact on Surgical Management

ROGER L. CLICK, MD, PHD; MARTIN D. ABEL, MD; AND HARTZELL V. SCHAFF, MD

- **Objective:** To determine the impact of intraoperative transesophageal echocardiography (IOTEE), an important adjunct in many types of cardiac surgical cases, on the surgical decisions made perioperatively in adult patients undergoing cardiac surgery.
- **Patients and Methods:** All adult patients who had cardiac surgery between 1993 and 1997 and who also had IOTEE were studied. New findings before and after cardiopulmonary bypass and alterations in the planned surgical procedure or management were documented prospectively.
- **Results:** A total of 3245 patients (60% men, 40% women; aged 18-93 years with a mean ± SD age of 62±15 years) were included in the study. The most common operations performed were mitral valve repair (26%) and aortic valve replacement (22%). Over the 5-year period, 41% of patients had IOTEE. New information was found before bypass in 15% of patients, directly affecting surgery in 14% of the patients. The most common new prebypass information found was patent foramen ovale resulting in closure in the majority of patients. New information was found after bypass in 6% of the patients, resulting in a change in surgery or hemodynamic management in 4% of the total. The most common postbypass finding was valvular dysfunction with repeat bypass in most patients for re-repair or replacement. No major complications occurred.
- **Conclusion:** In adult patients undergoing cardiac surgery, IOTEE provides important information both before and after bypass that affects surgical and hemodynamic management.


CABG = coronary artery bypass graft; IOTEE = intraoperative transesophageal echocardiography; LVOT = left ventricular outflow tract; PFO = patent foramen ovale
A safety net

Pre bypass
- Confirm Diagnosis
- Any new findings?
- Change surgical plan?
IOTEE

60 yo male
CAD
CABG
Hx of PAF
IOTEE prior to CABG
LAA thrombus
Check LAA carefully:

- AF or PAF
- MV stenosis
- MV prosthesis
IOTEE

62 yo male
3 vessel CAD
For CABG
IOTEE
IOTEE

75 yo male
Ascending aortic aneurysm
Aortic regurgitation
IOTEE

PRE BYPASS

FR 50Hz
10cm

2D
66%
C 50
P Off
Gen

PAT T: 37.0C
TEE T: 38.5C

55 bpm
65 yo male with stroke
35 yo male
Hx of endocarditis
Aortic regurgitation
IOTEE

Hx of SBE  Where is the leak?
IOTEE
# IOTEE

## New Prebypass Findings

<table>
<thead>
<tr>
<th>New Finding</th>
<th># Pts</th>
<th>Impact</th>
<th># Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV not abn.</td>
<td>96</td>
<td>Not inspect valve</td>
<td>95</td>
</tr>
<tr>
<td>PFO</td>
<td>100</td>
<td>PFO closed</td>
<td>88</td>
</tr>
<tr>
<td>TV or AV abn.</td>
<td>72</td>
<td>TV or AV surgery</td>
<td>68</td>
</tr>
<tr>
<td>Thrombus</td>
<td>37</td>
<td>Removed</td>
<td>36</td>
</tr>
<tr>
<td>Homograft size</td>
<td>31</td>
<td>Select size</td>
<td>31</td>
</tr>
<tr>
<td>MV abn.</td>
<td>27</td>
<td>MV inspect</td>
<td>23</td>
</tr>
<tr>
<td>MR etiology</td>
<td>27</td>
<td>MV repair</td>
<td>20</td>
</tr>
<tr>
<td>TV or AV not abn.</td>
<td>23</td>
<td>Not inspect valve</td>
<td>23</td>
</tr>
<tr>
<td>Reason for ↓BP</td>
<td>10</td>
<td>Altered med/surg mgmt</td>
<td>10</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>57</td>
<td>Altered surgery</td>
<td>47</td>
</tr>
</tbody>
</table>

**Total:** 480 (15%)  
**Total:** 441 (14%)  

*480/3245 Adult Cases (1993-1997)*
Post bypass
• Confirm Surgical result
• Any new findings
• Go back on bypass?

A safety net
IOTEE
What can go wrong?

Breaking the Bad News?
IOTEE

66 yo male
MVR
Mechanical bileaflet
IOTEE

Post IOTEE

Whatsamatterhere?
IOTEE
IOTEE

64 yo female

History of RHD

Scheduled MVR

IOTEE performed
IOTEE
Mitral valve replaced

*No* thrombus found
Post MVR IOTEE
What to do next?

1. Looks good, finish up
2. Change shorts
3. Immediate back on bypass
What to do next?

1. Looks good, finish up
2. Change shorts
3. Immediate back on bypass
IOTEE

64 yo female
Hx Endocarditis
For MVR
IOTEE

Post tissue MVR IOTEE
IOTEE
IOTEE

A new valve
IOTEE

67 yo male
Hx CHF
Severe MR
For MVR
IOTEE
IOTEE
IOTEE

Post MV repair Where is the leak?
65 yo male

AV surgery
IOTEE

More Air
67 yo male
For mitral valve repair
Big time SAM
IOTEE

Esmolol, fluids, rate control. BP management
IOTEE

72 yo male
Mitral Valve surgery
IOTEE

Pre MV repair echo
Pre MV repair echo
IOTEE

Post MV repair echo
IOTEE
### Intraoperative TEE
#### New Postbypass Findings

<table>
<thead>
<tr>
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<th># Pts</th>
<th>Impact</th>
<th># Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native valve abn.</td>
<td>53</td>
<td>Valve repair/replace</td>
<td>32</td>
</tr>
<tr>
<td>LV abn, RWMA</td>
<td>45</td>
<td>Inotropic/IABP return to bypass</td>
<td>31</td>
</tr>
<tr>
<td>SAM</td>
<td>27</td>
<td>Decrease inotropic volume expansion</td>
<td>22</td>
</tr>
<tr>
<td>Perivalve Regurg</td>
<td>18</td>
<td>Repair</td>
<td>10</td>
</tr>
<tr>
<td>Misc</td>
<td>37</td>
<td>Alter management</td>
<td>24</td>
</tr>
</tbody>
</table>

180 (6%) 119 (4%)

**480/3245 Adult Cases**
(1993-1997)
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Heart bypass surgery typically costs about $70,000-$200,000.

Heart valve replacement surgery typically costs $80,000-$200,000.

The average, according to an American Heart Association report, of $164,238, not including the doctor fee. A surgeon fee can add $5,000 or more to the final bill.

A standard echocardiogram can cost $1,000 to $2,000, and a TEE can cost $2,000.

Surgery - $164,238
TEE - $1642.38

Need 1/100 to have impact to be cost effective
Have 9/100 impact
IOTEE
Impact on Emergency Surgery

Reason for IOTEE

66 patients who had Emergency IOTEE

• Unexplained Homodynamic Instability - 36
• Preop eval for Emergent Surgery - 19
• Cardiac Evaluation for Trauma - 6
• Hypoxemia - 5

Brandt, JASE, 1998
IOTEE
Impact on Emergency Surgery

Impact of IOTEE

15 patients - 23%

• New Aortic Dissections - 2
• New Shunt - 3
• New Ischemia - 3
• New Valvular abnormalities - 7

Brandt, JASE, 1998
IOTEE

Overview

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Missed Diagnosis

I Missed What?
IOTEE

24 yo male

History of endocarditis

Surgery for AR
Prebypass Echo
Surgical findings
IOTEE
Missed Diagnosis

• 1918 patients
  – 48 discordant findings (2.5%)
  – Most valve pathology (92%)
    – perforations
    – ruptured chordae
  – Functional (8%)
    – severity of stenosis/regurgitation
  – Altered surgical plan 0.3%

Chaliki, JASE, 1999
The Disappearing Mass
64 yo male for CABG

IOTEE
Prebypass TEE
Patient placed on bypass
RA opened
Nothing found
Nada
Zip
Zero
What to do next?

1. Complete CABG
2. Explore RV and PA
3. Echocardiographer is delusional needs psych consult
What to do next?

1. Complete CABG

2. Explore RV and PA - nothing found

3. Echocardiographer is delusional needs psych consult
CABG completed - TEE post bypass
Now what?

1. TEE Dr. referred for refresher course
2. Do nothing
3. Have surgeon reexplore
4. Pull probe don’t look anymore
IVC explored

Thrombus and tumor found

Diagnosis

Hypernephroma
An explanation?
Overview

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IOTEE Summary

• IOTEE routine in most CV surgeries
• Indications in other operations evolving
  Vascular, thoracic, neuro, emergency
• Surgical impact – 10%
• Emergency IOTEE impact - 23%
• Cost effective
• Missed diagnosis impact - 0.3%
• The technology continues to evolve
  Smaller machines, 3D echo