20 YEARS OF INNOVATION
TCT2008

Fully Integrated Invasive Imaging Solutions: On-line Networking of Angiography, IVUS, FFR, OCT, ICE, VP Imaging, Etc

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CARDIOVASCULAR RESEARCH FOUNDATION

COLUMBIA UNIVERSITY MEDICAL CENTER
NewYork-Presbyterian
The University Hospital of Columbia and Cornell

Prior to EuroPCR, physicians were asked to pick the top 3 reasons for not using IVUS

- I cannot afford it - 55.6%

- I have difficulties with image interpretation - 5.6%
- Takes too much time - 33.3%
- Does not reach difficult lesions – 25%
- Adds unnecessary risk to the procedure - 11.1%
- I am not an expert - 22.2%

- No evidence that it improves outcomes - 27.8%
- Good for studies, no need for it in practice - 27.8%
- Diagnostic tool, no therapeutic implication - 16.7%

How to be more efficient. . .

- Train Technicians*, Nurses, and/or Fellows
  - Knowledge of imaging systems, catheters, and imaging protocol(s)
  - Immediately available and patient care and flow of PCI procedure not interrupted
  - System and catheter preparation, image optimization and annotation
  - Make measurements, interpret images, and provide feedback to physician during procedure
  - Archive cases onto CDs
  - Keep procedure logs and generate reports
- The more you do, the more efficient you get.

Integrated IVUS Workflow

Historical IVUS Workflow

- Search for IVUS Console in neighboring labs
- If not in use, unplug and transport 400 lb. system
- Plug in console and ECG lead to power up
- Enter Patient information manually via keyboard
- Plug in catheter and begin imaging
- Trace borders
- Make measurements by hand
- Estimate tissue composition based on gray-scale 'shades'

BSC

- Enter Patient information manually via keyboard

Volcano

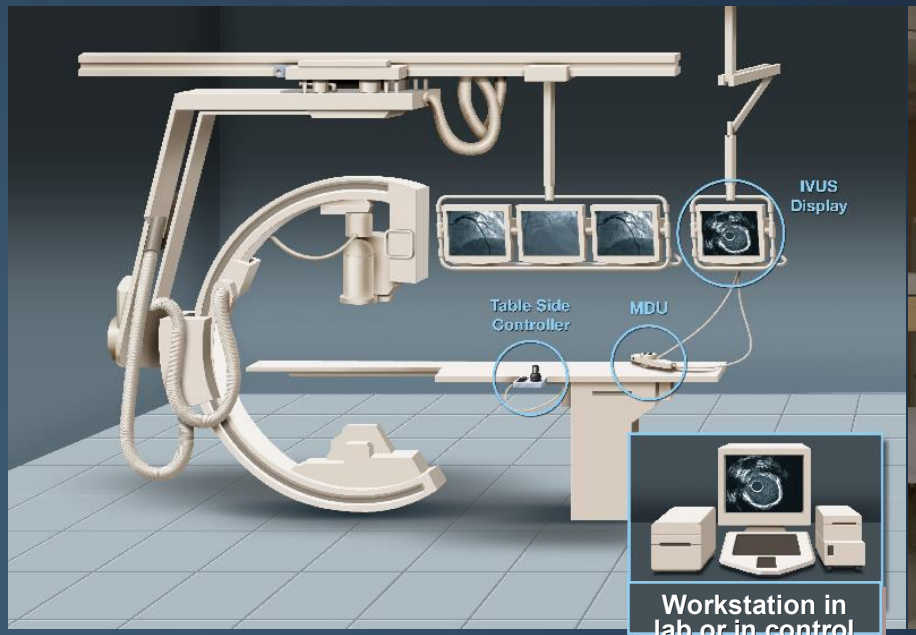
- Digital transfer of patient information via DICOM connection

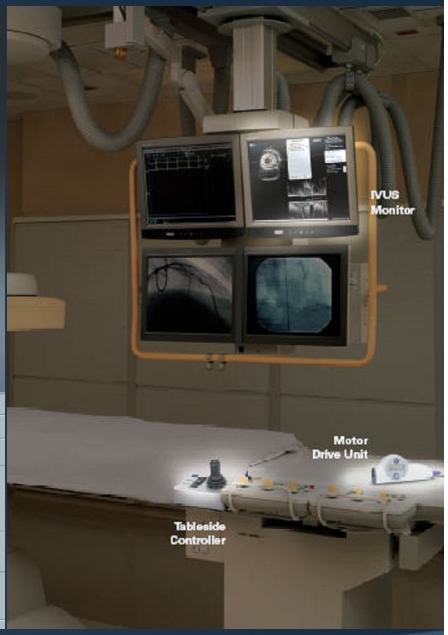
- Plug in catheter and begin imaging

- Confirm automatic borders & measurements

Volcano V-Fusion

BSC iLab





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Greyscale IVUS

- Perhaps the best all around technique for assessing overall atherosclerosis burden and unusual lesions pre-intervention; guiding interventional procedures - including intermediate lesion and LM disease assessment; stent and length sizing and stent optimization; and assessing stents at follow-up
- Limited usefulness in assessing plaque composition (except calcium), thrombus formation, vulnerable plaques
- The workhorse in the cath lab

Beyond greyscale IVUS. . .

Physiology (CFR/FFR)

ICE

Greyscale IVUS

Angioscopy

VH-IVUS

VP Imaging (Spectroscopy, etc)

OCT/OFDI

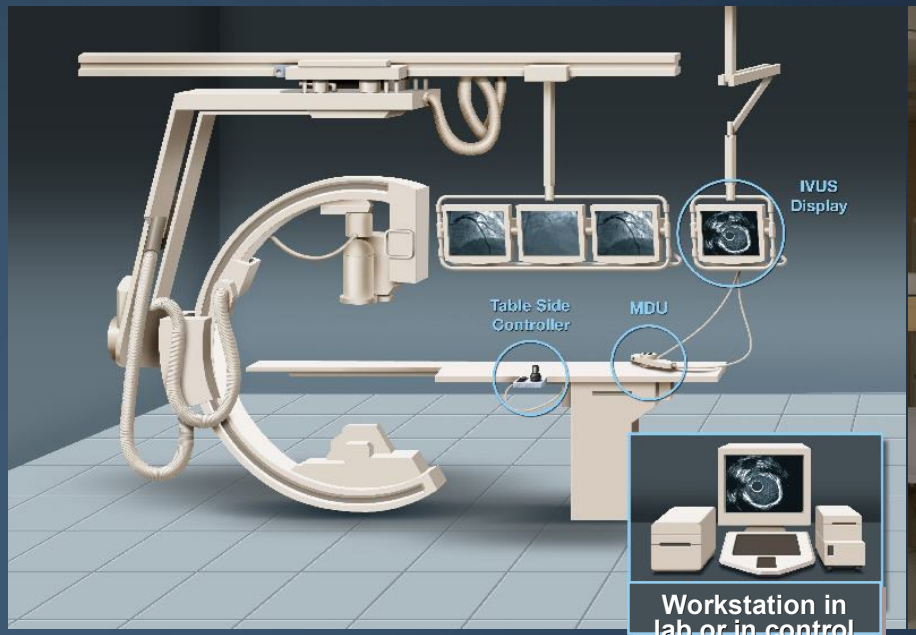
Non-invasive Imaging (From TEE to CTA to …)

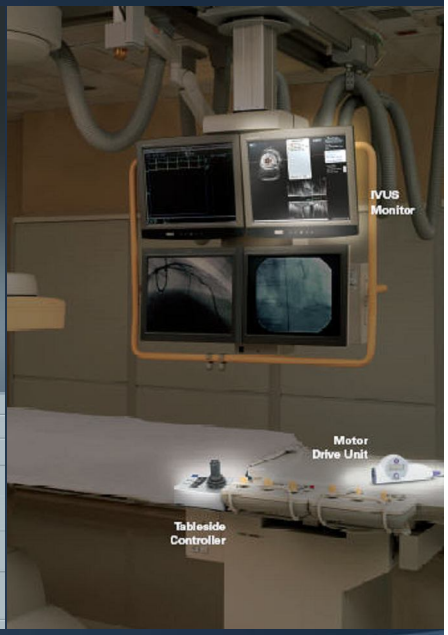
Physiology (CFR/FFR)

- Perhaps the best technique available for assessing the hemodynamic significance of intermediate (non-LM) lesions
- Not useful for selecting stent size and length
- Limited usefulness for optimizing stent expansion and lesion coverage

Volcano V-Fusion also includes FFR

BSC iLab





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VH/IB-IVUS

- Supplements greyscale IVUS by assessing plaque composition and detecting vulnerable plaques, but not thrombus
- Not a stand-alone technique – but this data is acquired at the same time as greyscale IVUS

VP Imaging

- Mulitple techniques – spectroscopy, palpography, VV imaging, etc.
- Not useful for assessing hemodynamic significance of intermediate lesions, guiding interventional procedures, or assessing stents at follow-up
- Probably not stand-alone techniques – but prototypes exist to combine some of these with greyscale IVUS

OCT/OFDI

- Perhaps the best all around technique for assessing vulnerable plaques and thrombus formation and, especially, for assessing stent malapposition, neointimal stent strut coverage, at follow-up.
- Has the potential to replace greyscale IVUS as the best all around technique for assessing lesions pre-intervention and guiding interventional procedures
- Limited usefulness for assessing overall atherosclerosis burden because of limited penetration
- Prototype designs exist to combine this with IVUS in a single catheter

Angioscopy

- Perhaps the best technique for assessing thrombus
- Also useful for assessing vulnerable and/or ruptured plaques and stent neointimal coverage

	TTE	TEE	ICE
Transseptal catheterization	+	++	++
Percutaneous balloon mitral valvulopasty	++	+++	++
Transseptal closure of ASD, PFO, VSD	+	++	++ (phased array)
Alcohol septal ablation of HOCM	++	++	-
Percutaneous MV repair	+	+++	+
Percutaneous LV assist device placement	-	++	++
Percutaneous stented AoV prosthesis placement	-	+	+
Balloon or blade atrial septostomy	++	++	++
Placement of LAA occlusion devices	-	++	++
Myocardial and intraventricular biopsy	++	++	++ (phased array)
Congenital heart applications (completion of Fontan procedure, coarctation repair, etc)	+	+	+
Placement of aortic endograft	-	-	+

- No documented role or benefit in the literature
+ Anecdotal reports of use and benefit exist, but further study is needed to delineate
++ Advantages favor use when available
+++ Clearly documented benefit or role.

(Silvestriet al. JASE 2009;22:213-231)

Ideal

Reality

The right tool for the right job

In clinical medicine when faced with a diagnostic or therapeutic decision, we must always choose the right tool for the right job. Invasive imaging is no different. None of the available tools is a single, all-in-one solution. All of them are important in specific situations. Physicians must learn to interpret and use these techniques correctly.

The next steps in image integration. . .

- We must be able to integrate these many modalities into the cath lab – physically and operationally.
- It is impractical and inefficient to have separate (and different) catheters, consoles, data management, and standard operating procedures for each technique
- The first step is to have one console – and, therefore, one data management and SOP – that can be used with multiple imaging catheters
- The second step is to have a single catheter perform multiple functions – i.e., combined ultrasound and optical imaging.

The next steps in image integration. . .

- Although the data files are large, invasive images need to be stored with or linked to the cineangiograms
  - There should be one patient record that contains the clinical record as well as all of the imaging data
  - All images (not just the cineangiograms) must be viewable as they occurred in sequence during the procedure – similar to the hyperlinks that I used in this presentation

The next steps in image integration. . .

- "Big iron" has been reluctant to share its storage storage by incorporating even IVUS - and greyscale IVUS studies are relatively small digital files compared to next generation imaging techniques.
- Fully integrated imaging may require a third party solution to provide huge, efficient, and expandable data storage facilities and algorithms.

The next steps in image integration. . .

- Once the images have been integrated into a network, they can become available for electronic transfer to
  - Core laboratory
  - Online image interpretation service
  - Electronic medical record filing
  - Referring and consulting physicians

A personnel-intense solution is no longer acceptable

- Train Technicians*, Nurses, and/or Fellows
  - Knowledge of imaging systems, catheters, and imaging protocol(s)
  - Immediately available and patient care and flow of PCI procedure not interrupted
  - System and catheter preparation, image optimization and annotation
  - Make measurements, interpret images, and provide feedback to physician during procedure
  - Data and image management

After a more than a decade of discussion, the first steps toward image integration have been accomplished with IVUS and FFR. Therefore, there is no reason that this cannot be extended to include other invasive imaging techniques.