

Abstract 023 Figure 2

# 024 VALIDATION OF TISSUE CHARACTERISATION AND VULNERABLE PLAQUE CLASSIFICATION USING VIRTUAL HISTOLOGY IVUS (VH-IVUS) AGAINST HUMAN POST-MORTEM HISTOLOGY

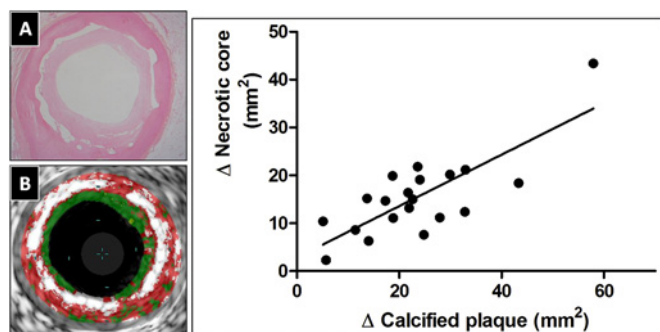
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**Introduction** VH-IVUS is increasingly used in clinical trials to classify vulnerable thin-capped fibroatheroma (TCFA). However, VH-IVUS has not been validated for classifying coronary plaque against the gold standard of human post-mortem histology.

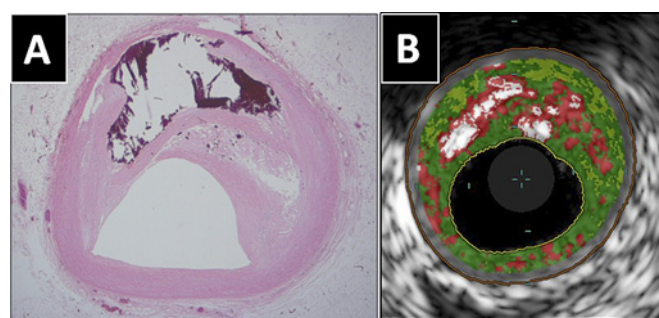
**Methods** Ten human coronary arteries were obtained at post-mortem. VH-IVUS examination was performed in a pressure-perfused system. The arteries were then fixed, stained and sectioned giving 72 co-registered 400  $\mu$ m segments. Slides from each segment were examined by a histopathologist to determine the presence of calcification, necrotic core and to classify any plaque present. A fibroatheroma was considered a TCFA if fibrous cap thickness was  $<65 \mu$ m. VH-IVUS analysis was performed on each segment to compare tissue characterisation and plaque classification by an operator blinded to the histology. To explore a possible link between VH-IVUS detection of calcification and necrotic core artefact we also performed VH-IVUS of coronary segments in 20 patients pre- and immediately post-stenting to determine if there was a relationship between increasing calcium (simulated by stent struts) and necrotic core.

**Results** VH-IVUS was excellent at determining the presence of atherosclerotic plaque (sensitivity-100%, specificity-93%) and calci-



Abstract 024 Figure 1 (A) Post-mortem histology demonstrating presence of calcification and necrotic core with co-registered VH-IVUS (B) (necrotic core = red, calcium = white).

fication (sensitivity-96%, specificity-90%) (Abstract 024 figure 1). Necrotic core was detected with a sensitivity of 100% but a specificity of 40%. For classification of a fibroatheroma by VH-IVUS (confluent NC  $>10\%$  of plaque area for three consecutive frames) sensitivity was 87% and specificity-74%. Of the 24 segments wrongly attributed to contain necrotic core by VH-IVUS, 92% also contained calcium (67% contained  $>10\%$  calcium). Stent struts are mistaken by VH-IVUS as calcification, surrounded by necrotic core not present on histology (Abstract 024 figure 2). Analysis of arterial segments pre- and post-stenting showed a linear correlation between increasing calcium (stent struts) with increases in necrotic core ( $r^2=0.61$ ) suggesting some necrotic core surrounding calcium maybe artefact. VH-IVUS distinguished TCFA (fibroatheroma with core in contact with lumen) with sensitivity-71% and specificity-74%. As  $65 \mu$ m is beyond the spatial resolution of VH-IVUS we repeated the analysis with caps  $<200 \mu$ m considered thin and the sensitivity of VH-IVUS to detect TCFA rose to 80%, specificity-76% (Abstract 024 table 1).



Abstract 024 Figure 2 Left : (A) Post-mortem histology demonstrated coronary segment with stent struts but no significant necrotic core. (B) Co-registered VH-IVUS image showing stent struts mistaken for calcium with necrotic core artefact. Right: Linear correlation between increase in calcified plaque and increase in necrotic core in coronary segments pre- and post-stenting.

Abstract 024 Table 1

Histology defined plaque	Correctly classified by VH-IVUS
All Fibroatheroma	26/30 (87%)
Calcified Fibroatheroma	18/26 (69%)
Fibrocalcific	9/24 (38%)
All TCFA (cap $<65 \mu$ m)	5/7 (71%)
Calcified TCFA (cap $<65 \mu$ m)	3/6 (50%)
All TCFA (cap $<200 \mu$ m)	8/10 (80%)

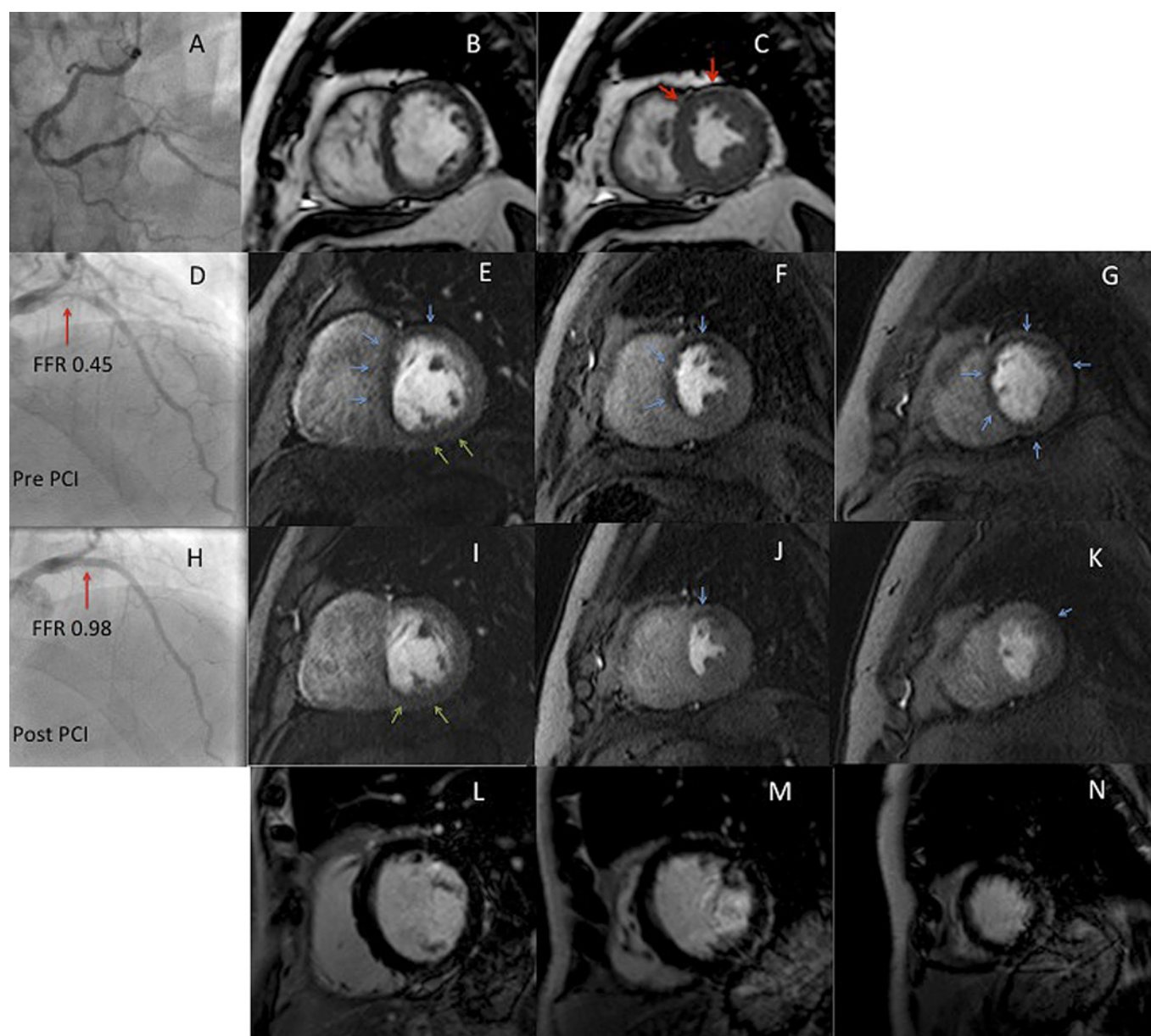
**Conclusion** In comparison with histology, VH-IVUS reliably discriminated calcified plaque and detected necrotic core (classifying fibroatheromas) with good sensitivity. However, the specificity to detect necrotic core dropped in the presence of dense calcification due to necrotic core artefact. The sensitivity and specificity to detect TCFA was also limited by VH-IVUS spatial resolution.

# 025 FEASIBILITY OF COMBINED CARDIOVASCULAR MRI AND PERCUTANEOUS CORONARY INTERVENTION IN A HYBRID LABORATORY

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**Background** The relationship between anatomy and associated pathophysiology in coronary artery disease (CAD) is complex and



Abstract 025 Figure 1

incompletely understood yet is important for patient management. This information cannot be comprehensively provided by a single investigative modality. A hybrid x-ray and MRI (XMR) laboratory can potentially overcome this limitation. However, the feasibility of combined invasive and non-invasive studies and percutaneous coronary intervention (PCI) in an XMR laboratory is unknown.

**Methods** 10 patients with angina scheduled for coronary angiography or PCI underwent combined procedures in an XMR laboratory. 3T Cardiovascular Magnetic Resonance (CMR) exams included serial high-resolution perfusion, functional and scar imaging. Invasive procedures included diagnostic coronary angiography, PCI and fractional flow reserve (FFR) measurements pre and post PCI.

**Results** Four females and 6 males with mean age 73 (range 51–86) were included. All procedures were completed and well tolerated without complication. Mean study duration was 117 min (range 36–208). The procedures and outcomes are summarised in

Abstract 025 table 1. Eight patients underwent both CMR and invasive studies. Six patients had single vessel PCI. FFR and stress perfusion imaging were both performed in 14 coronary territories (4 post PCI). Management was guided by functional information in eight patients. An example case is shown in Abstract 025 figure 1. End-diastolic (B) and end-systolic (C) frames from the short axis cine demonstrate an anterior/anteroseptal wall motion abnormality. Stress perfusion imaging pre PCI demonstrated a severe perfusion defect in the LAD territory from base to apex (E–G; blue arrows) and a defect in the RCA territory (E; green arrows). There were corresponding severe lesions in the proximal LAD with an FFR of 0.45 (D) and RCA (A). Following PCI to the LAD FFR increased to 0.98 and stress perfusion was significantly improved (I–K). The RCA territory defect remained (I; green arrows) but there was also persistent hypoperfusion in the mid anterior slice (J; blue arrow) and apical lateral wall (K; blue arrow) despite the absence of scar on late gadolinium enhancement imaging (L–N).

Abstract 025 Table 1

Patient number	Age	Sex	Coronary disease	CMR stress perfusion	FFR pre PCI	FFR post PCI	Outcome
1	65	F	Minor	N/A	N/A		Medical
2	77	M	LAD Cx	Negative	N/A		Medical
3	71	M	RCA	N/A			PCI RCA
4	76	F	LAD	Positive	0.68		PCI LAD
5	79	M	LAD	Positive	0.38	0.92	PCI LAD
6	79	F	LAD Cx	Negative	0.73	0.83	PCI LAD
7	86	F	LAD	Scar	N/A		Medical
8	61	M	Cx RCA	Positive	0.55	0.95	PCI Cx
9	75	M	LAD Cx RCA	Negative	0.83		Medical
10	51	M	LAD Cx RCA	Negative	0.91		
				Positive	0.45	0.98	PCI LAD
				Negative	0.96		
				Positive			

Cx, circumflex artery; LAD, left anterior descending artery; RCA, right coronary artery.

**Conclusions** Combined CMR and interventional coronary procedures are feasible and well tolerated in an XMR laboratory. This set-up has exciting research and clinical applications which should improve knowledge and management of coronary artery disease.

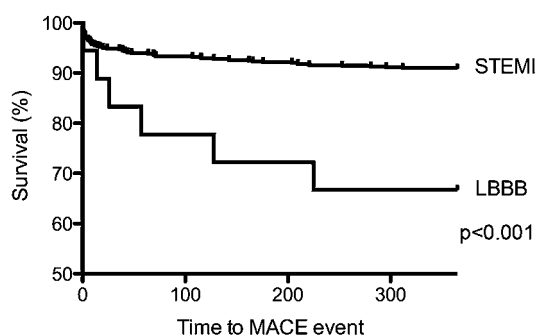
## 026 LEFT BUNDLE BRANCH BLOCK AS AN ACTIVATION CRITERION FOR PRIMARY PERCUTANEOUS CORONARY INTERVENTION: WHERE IS THE EVIDENCE?

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**Background** The activation criteria for primary percutaneous coronary intervention (PPCI) includes chest pain in association with either ST-segment elevation (STEMI) or new-onset left bundle branch block (LBBB) on the ECG. However, defining LBBB as new is challenging acutely and the poor specificity of indeterminate chronicity LBBB may result in unnecessary PPCI activations. Published data are conflicting with regard to the utility of LBBB as a triage criterion for PPCI and subsequent outcomes are undefined.

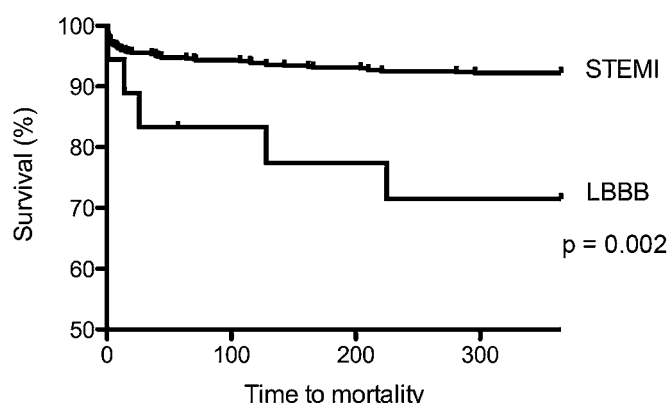
**Methods** Consecutive patients attending a single UK tertiary centre for presumed PPCI between September 2008 and December 2010 were included (n=1328). The activation ECG was obtained from the hospital PPCI database, as were demographic data. Outcome data were obtained from notes and national databases. MACE was defined as a composite of mortality and unplanned revascularisation. Two interventionists blinded to patient outcome reviewed the angiographic images and adjudicated if the activation was appropriate.



Abstract 026 Figure 1

**Results** Chest pain with LBBB (LBBB-activation) occurred in 88 patients (6.6%) of the PPCI cohort. Comparing LBBB-activations to those with STEMI demonstrated that LBBB-activations were older (mean age  $70.3 \pm 12.4$  vs  $64.6 \pm 13.4$  years;  $p < 0.001$ ) and less likely to be male (67.0% vs 76.8%;  $p = 0.004$ ). Otherwise, baseline demographics were similar. Eighteen (20.5%) patients with LBBB had an acute thrombotic coronary occlusion confirmed at angiography and received PPCI. The final adjudicated diagnoses for LBBB-activations were acute coronary syndrome (ACS) (39.8%), non-ACS cardiac (28.4%) and non-cardiac (31.8%). A history of previous MI ( $p = 0.002$ ) and presence of cardiogenic shock on arrival ( $p = 0.04$ ) were more prevalent in the appropriate LBBB-activations. One-year mortality and MACE were higher for appropriate LBBB-activations than the STEMI activations (27.8% vs 7.9%;  $p = 0.002$  (Abstract 026 figure 1) and 33.3% vs 9.1%;  $p < 0.001$  respectively).

**Conclusions** Less than half of LBBB-activations had an ACS and, of these, only half had a thrombotic coronary occlusion requiring PPCI. However, LBBB-activations have a significantly worse prognosis and merit urgent referral. Enhanced triage methods are required to correctly identify acute MI requiring PPCI in those with LBBB.



Abstract 026 Figure 2

## 027 PERCUTANEOUS CORONARY INTERVENTION IN OCTOGENARIANS: RESULTS FROM A HIGH VOLUME CENTRE

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**Aims** Octogenarians constitute a fast growing group of patients referred for percutaneous coronary intervention (PCI) for stable angina and acute coronary syndromes (ACS). However, there are limited outcome data for PCI in this group. We evaluated the outcome of PCI in patients aged  $\geq 80$  years and compared them with younger patients treated in our centre.

**Methods** We analysed all patients aged  $\geq 80$  years who underwent PCI in our unit between September 2009 and December 2010. Prospectively entered data were obtained from our dedicated cardiac service database system (Philips CVIS). Mortality data were obtained from the summary care record (SCR) database. Follow-up data were obtained from patients' respective district general hospitals and general practitioners' medical records. We defined major bleeding as anyone requiring at least one unit of red cell transfusion.

**Results** Of the 2931 patients who underwent PCI in our unit during the study period, 401 (13.7%) patients were  $\geq 80$  years of age. Out of this 163 (40.6%) had primary PCI (PPCI) for STEMI, 120 (29.9%)