3-DIMENSIONAL RECONSTRUCTION OF VASCULAR LUMEN FROM IMAGES RECORDED DURING PERCUTANEOUS 2-D INTRAVASCULAR ULTRASOUND.

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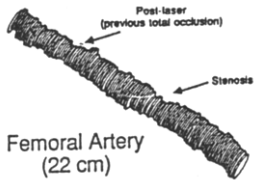
The development of intravascular ultrasound (IVUS) has provided the opportunity to record serial tomographic cross-sectional (2-D) images of the vascular lumen (VL) that may complement conventional angiography. We reconstructed 3-dimensional (3-D) images of the vascular lumen depicted by IVUS images, as a means of facilitating analysis of morphologic abnormalities of VL at sites of stenosis. Complex alterations in vascular wall resulting from interventional therapy, such as cracks, dissections, and flaps, were incorporated into the reconstructions (R). In 6 cases, 2-D IVUS images were serially recorded during interventional therapy of peripheral vascular disease. 3-D R was then performed on segments of artery up to 20 cm long. In 3 cases, 3-D R was performed before and after recanalization by balloon angioplasty, laser, and/or atherectomy; in 1 case of laser-induced dissections, 3-D R of true and false lumens was performed. This preliminary work suggests that 3-D R may enhance analysis of 2-D IVUS exam. Future computer-generated 3-D R may provide on-line images for use during interventional procedures.



INTRAVASCULAR CORONARY ULTRASOUND ASSESSMENT POST ELECTIVE PERCUTANEOUS TRANSLUMINAL CORONARY ANGIOPLASTY

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We present the first use of Intravascular Coronary Ultrasound (IVCUS) to evaluate the human coronary artery following elective percutaneous transluminal coronary angioplasty (PTCA). Our primary goals were 1) to determine the safety of this over-the-wire device in a small group of patients post PTCA, 2) to determine the device trackability and flexibility in multiple coronary locations, and 3) to obtain intravascular images proximal to and within the freshly dilated vessel. The device we utilized was a 5.5 French (1.8 mm) phased array ultrasound catheter (Endosonics) advanced over an .014 guidewire. Ten vessels in 8 patients, mean age 64, 2 female and 6 male underwent ultrasound. We examined 4 left anterior descending, 3 right, 2 left circumflex, and 1 diagonal vessel. All vessels were evaluated without evidence of spasm, dissection, thrombus, embolization or cardiac arrhythmias. Images were obtained proximal to and across the freshly dilated segment. Trackability and flexibility of the device was fair following 2.5 mm. balloon inflations and better following 3.0, 3.5 and 4.0 mm. balloon inflations. Following 2.5 mm. balloon inflation delineation of vascular morphology was less apparent than after a 3.0 mm. or greater balloon. Dissections from intima to media correlated well with angiographic data. We conclude: 1) the device can safely examine larger vessels post PTCA, 2) device trackability and flexibility is adequate, and 3) further improvement in phased array technology is needed for more precise delineation vascular morphology, particularly in smaller vessels.

Left Pulmonary Artery Morphology and Flow after Ductal Occlusion with the Rashkind Prothesis

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After transcatheter occlusion of the patent ductus arteriosus using the Rashkind prothesis the proximal arms of the double umbrella device may sit close to the origin of the left pulmonary artery (LPA). To determine the extent and severity of stenosis of the LPA following transcatheter occlusion, LPA morphology and blood flow were evaluated by pulsed Doppler echocardiography and angiography. Doppler velocity shifts across the LPA were measured in 93 consecutive patients immediately after occlusion; 30 patients after surgical ligation and 23 children with normal hearts. An increased velocity shift of 0.32 ± 0.39 m/sec occurred in the ductal occlusion group compared to contols. Seven (8%) had velocity shifts of >1m/sec while no control patient had shifts of this magnitude. In 20 patients at angiography narrowing of >15% of the lumen diameter was found after occlusion in 9 (45%). There was no relationship between Doppler velocity shifts across the LPA and angiographic narrowing. Angiographic evidence of mild LPA stenosis occurs in almost half of patients undergoing ductal occlusion, however, this appears not to significantly alter the hemodynamics across the LPA.

FUNCTIONAL SIGNIFICANCE OF ARTERIAL STENOSES PREDICTED BY ANGIOGRAPHY AND INTRAVASCULAR ULTRASOUND IMAGING CATHETER

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Intravascular ultrasound imaging provides a direct measure of the cross-sectional area of a stenotic artery. The purpose of this study was to determine whether intravascular ultrasound imaging also reflects the functional significance of the stenosis compared to measurements made during angiography (ANGIO). Pig arteries (10 cm long) had variable degrees of stenosis (50-90% area) created artificially by a plastic constrictor. The arteries were perfused with a viscous sucrose solution to simulate blood. The flow-pressure relationship was determined at each level of stenosis by increasing the flow with a roller pump while measuring the pressure loss (ΔP) across the stenosis. Orthogonal ANGIO and intravascular ultrasound images were obtained under the same driving pressure. Area measurements were performed at the normal and stenotic portions. Predicted ΔP by ANGIO and intravascular ultrasound imaging were obtained using the Pouiselle equation and was compared to the actual ΔP at each flow level (n=49). Close correlations were obtained with both methods (r=0.98 by ANGIO and 0.97 by intravascular ultrasound) but the degree of stenosis obstruction was over-estimated by ANGIO for the tighter stenosis (Y=6.81X+31) compared to intravascular ultrasound imaging (Y=.92X-4). Ultrasound intravascular imaging is useful in determining the functional as well as the anatomical significance of a stenosis. Intravascular ultrasound imaging may be more sensitive than ANGIO because intravascular ultrasound imaging measures the cross-sectional area directly.