GRAPHICAL ENTRY, DISPLAY AND REPORT GENERATION OF CORONARY ANGIOGRAPHY DATA USING A COMPUTERIZED CORONARY TREE DIAGRAM

Ross A. Davies[1], Stephan Donati[2], Jean-Francois Marquis[3].

Division of Cardiology, University of Ottawa Heart Institute[1,3] and Fortisoft Corporation[2],
Ottawa, Ontario, Canada.

ABSTRACT

Coronary tree diagrams are widely used for computer data entry of coronary stenoses on angiography. However, they often use straight lines which do not resemble coronary anatomy, they require increased operator training and the printed report is hard to interpret. Patient Database Management Software © was written using PowerBuilder™ - a Windows application development language, with Microsoft SQL Server™ as the database engine, running on a Windows NT™ server using a Novell™ network. A computer coronary tree was drawn based on the Coronary Artery Surgery Study (CASS) model. There is a hidden button behind each coronary segment on the graphic. When this is 'double clicked' with the mouse, the user enters the percent stenosis on a pop up menu. The stenosis is displayed visually, however, the data is stored in a table in the database (e.g. segment #2: mid right coronary artery- RCA, 100%) which results in lower data storage requirements. Graphical data entry, display and reporting of coronary angiography data which resembles the underlying coronary anatomy has the potential of better physician acceptance than the current method using standard alphanumeric text.

BACKGROUND

Much of cardiology data is composed of images such as the coronary angiogram, echocardiogram or myocardial perfusion. These modalities are rapidly moving from analog film or videotape to a digital format. However, each imaging modality is often stand alone and vendor specific. Some imaging modalities such as coronary angiography have standardized to a vendor-independent DICOM (Digital Imaging and Communications in Medicine) format.[1] However, the storage requirements for a single patient coronary angiogram are large requiring an entire CD, so this makes it hard to transmit the study over a network or to incorporate images in a report. Most reports are text based, however, this requires alphanumeric data entry and does not present the data in graphical form intuitive to the reader. Also, the reports are often generated with stand alone, vendor-specific and proprietary hardware and software which does not lend itself to networking and access from a single Electronic Health Record.

## COMPUTERIZATION OF THE CORONARY ARTERY DIAGRAM

Patient Database Management Software (© R. A. Davies)[2-4] was written using PowerBuilder (version 8)™ - a Windows application development language with Microsoft SQL Server™ as the database engine. This runs on a Windows NT™ server over a Novell™ network. The development philosophy is patient oriented software design[5] or the ability to access all aspects of a patients medical record from a single workstation. The software development is an ongoing work in progress.

Widows icons include patient registration, patient selection, encounter review, clinical data, medications, routine lab data, cardiac lab data, documents, appointments, report generation and others. When the cardiac lab data icon is selected, the different cardiac tests are displayed in a tab format. Cardiac lab data includes coronary angiography, hemodynamics, echocardiography, myocardial perfusion, exercise electrocardiography, cardiac biopsy and others.

Left heart catheterization is performed by inserting a catheter percutaneously into a peripheral artery and injecting radio-opaque contrast into the coronary arteries (selective right and left coronary angiography) or the left ventricle (left ventricular angiogram). Cine flouroscopy images are digitized and archived in DICOM format. Intra-cardiac pressures or hemodynamics are also measured. The coronary angiogram data window is separate from the hemodynamic data window, since hemodynamic data may be recorded without angiography, for example, right heart pressures can be recorded in the coronary care unit using a Swan Ganz catheter inserted into the jugular vein.

The coronary angiography data widow consists of four pages selected with a radio button (figure 1): summary (text), coronary diagram, coronary intervention and LV (left ventricular angiogram) diagram.

Figure 1: Selection of Pages in Coronary Angiography Data Window
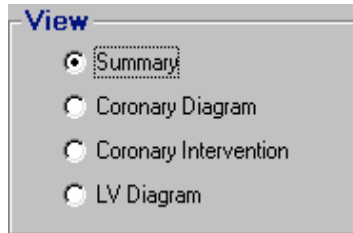
Coronary tree diagrams are widely used for computer data entry of coronary stenoses on angiography, however, they often use straight lines which do not resemble coronary anatomy, they require increased operator training and the printed report is hard to interpret. A computer coronary tree (figure 2) was drawn based on the Coronary Artery Surgery Study (CASS) model, which has become a widely used standard.[6] There is a hidden button behind each coronary segment on the graphic. When this is selected with the mouse, the user enters the percent narrowing or stenosis on a pop up menu (figure 3). The stenosis is displayed visually, however, the data is stored in a table in the database (e.g. segment #2: mid right coronary artery- RCA, 100%) which results in lower data storage requirements. Other lesion characteristics such as lesion description and vessel size are also recorded.

Figure 2: Coronary Angiography Diagram   Figure 3: Pop-up Menu for Entry of Lesion Data
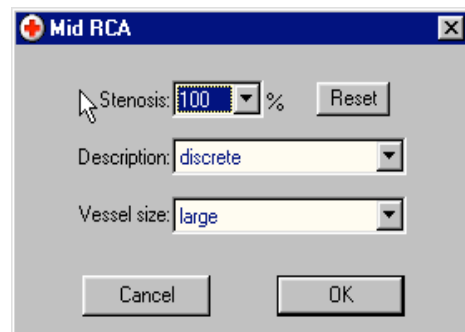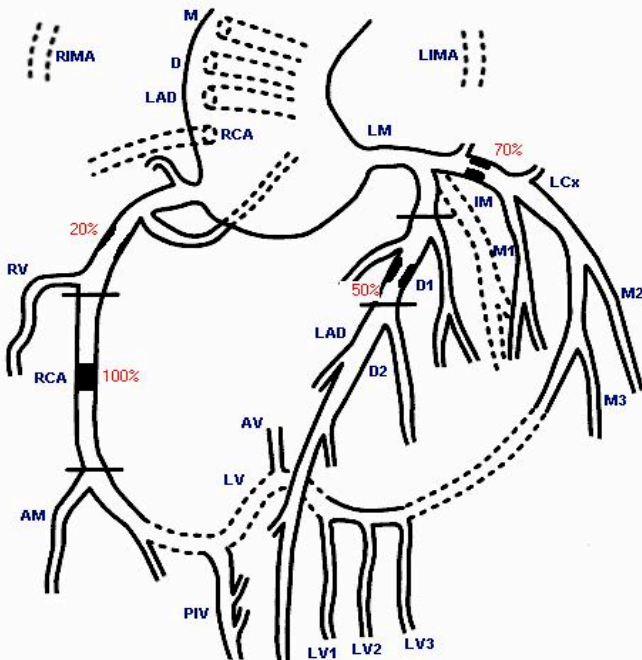

Coronary artery stenoses may be treated either by coronary artery bypass grafting (CABG) or by percutaneous coronary intervention (PCI). Bypass surgery uses either a venous or arterial conduit to carry blood around the obstructed coronary artery segment. Saphenous vein grafts harvested from the leg can be used to graft the right coronary artery (RCA), left anterior descending (LAD) coronary artery or its diagonal branches (D1 or D2) or the marginal branches (M1, M2 or M3) of the left circumflex (LCx) coronary artery. Arterial conduits (hatched lines on coronary artery diagram) can be created using either the right (RIMA) or left (LIMA) internal mammary (thoracic) arteries. If obstructions later develop in these bypass grafts, they can be recorded on the coronary angiogram diagram.

Increasing, severe coronary artery narrowings are being opened by balloon dilatation by means of percutaneous

transluminal coronary angioplasty (PTCA) or more recently by means of a coronary stent (Figure 4). This coronary intervention is entered by clicking on the coronary segment and entering the post intervention percent residual stenosis (usually 0%) and the method (Figure 5). The coronary intervention diagram shows the post procedure results. Residual narrowings that are not treated continue to be displayed reflecting the true post procedure result.

Figure 4: Coronary Intervention Diagram   Figure 5: Pop-up Menu for Entry of PCI Data
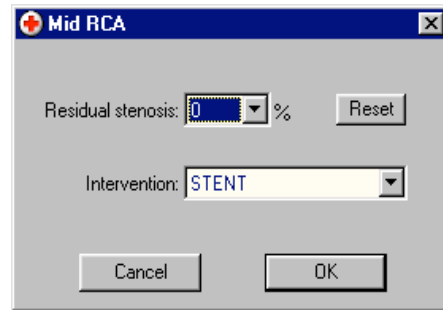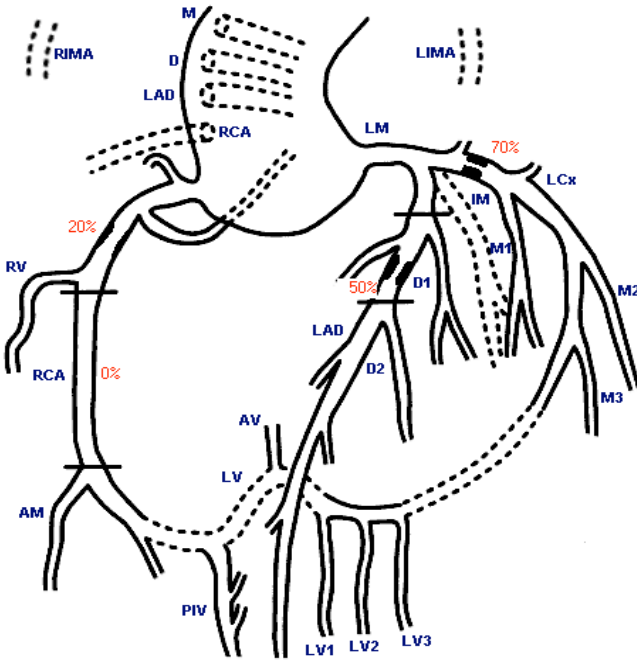
Left ventricular (LV) function is assessed by injecting radio-opaque contrast into the ventricle (a left ventricular angiogram) in the right anterior oblique (RAO) and sometimes in the left anterior oblique (LAO) projection (Figure 6). Segmental wall motion is entered by clicking on the left ventricular wall and selecting from a pop-up menu (normal, mildly hypokinetic, moderately hypokinetic, akinetic or dyskinetic).

Figure 6: LV Diagram
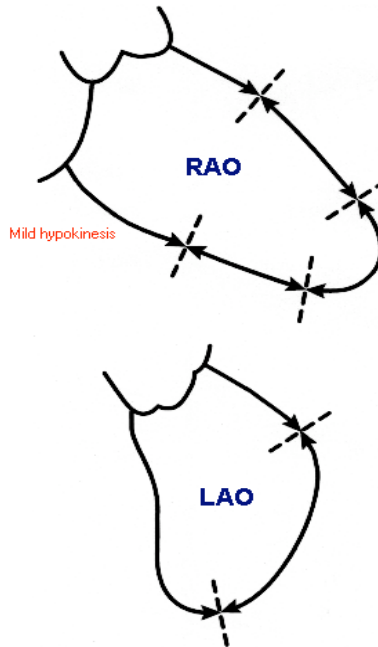
CONCLUSION

Graphical data entry, display and reporting of coronary angiography data which resembles the underlying coronary anatomy has the potential of better physician acceptance than the current method using standard alphanumeric text.

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