

How to Learn MRI

An Illustrated Workbook

Exercise 15: Maximum Intensity Projection (MIP) Images

Teaching Points:

- Learn how to reconstruct a 3D Image.
- Learn how to measure the renal artery diameter.
- Learn how to measure kidney length and parenchymal thickness.
- Learn about Renal Artery Blood-Flow Graph.

Part I: Reconstructing a 3D Image

Go to Browser. Highlight the name of the patient and the sequence you want to reconstruct, and then click 3D MIP on the Applications.

Four windows will appear on the screen showing the image on 3D, Axial, Sagittal, and Coronal views. For the plane to appear on the upper right hand window, change the Axial View to Oblique and click the **Rotating Plane tool** on the left hand side of the screen (Fig 15.2). Position the plane to the angle of your choice in order to view the vessel clearly.

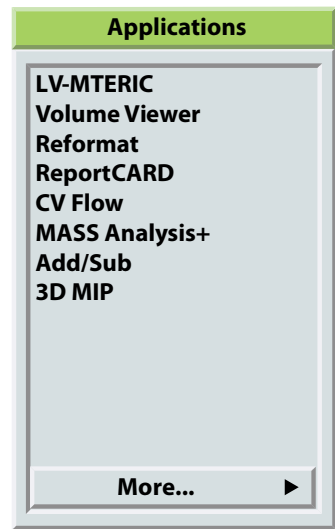


Fig 15.1 3D MIP Application

Make sure that the upper left hand window is in **3D** view, and then click the **Rotating box tool** (Fig 15.2). The box that will appear on the window that will allow you to rotate the image at different angles for easier reconstruction (Fig 15.3).

Fig 15.2 Window images of 3D MIP

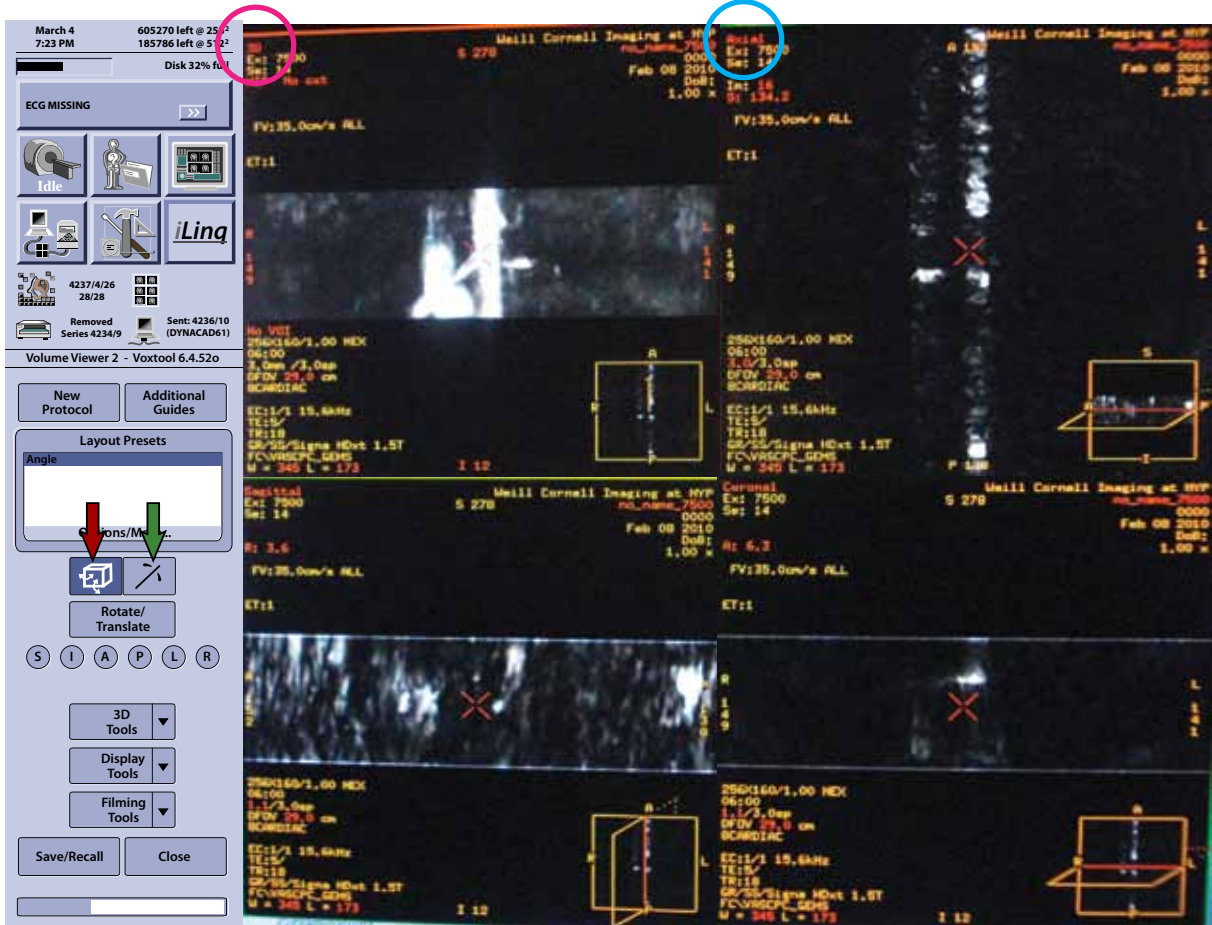
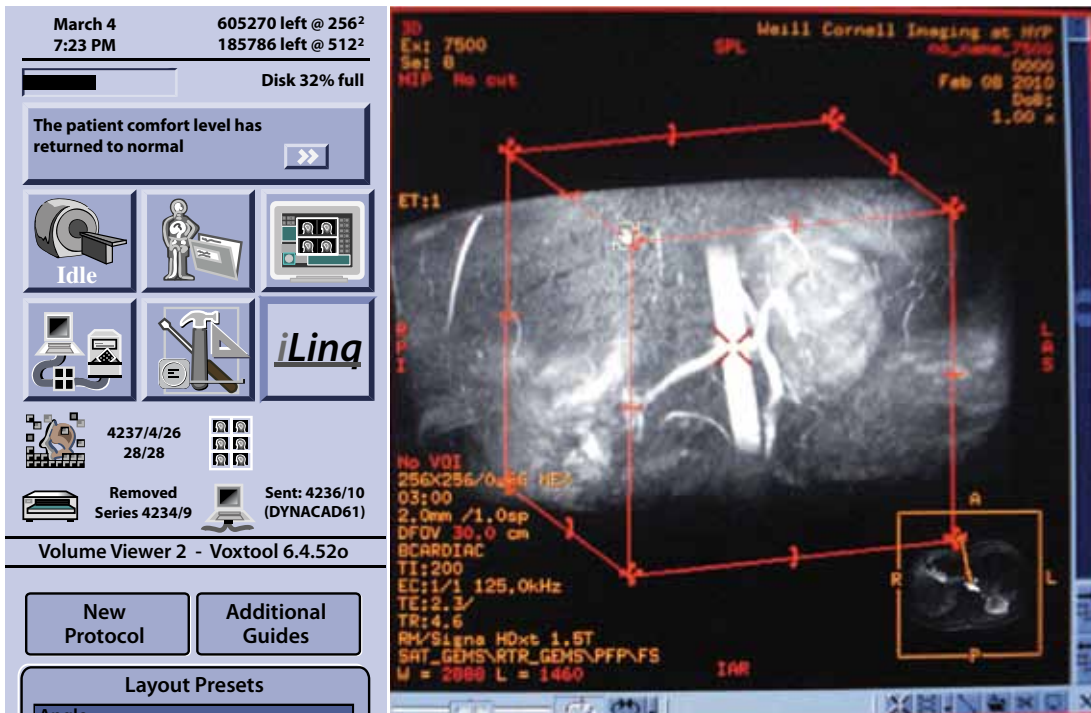
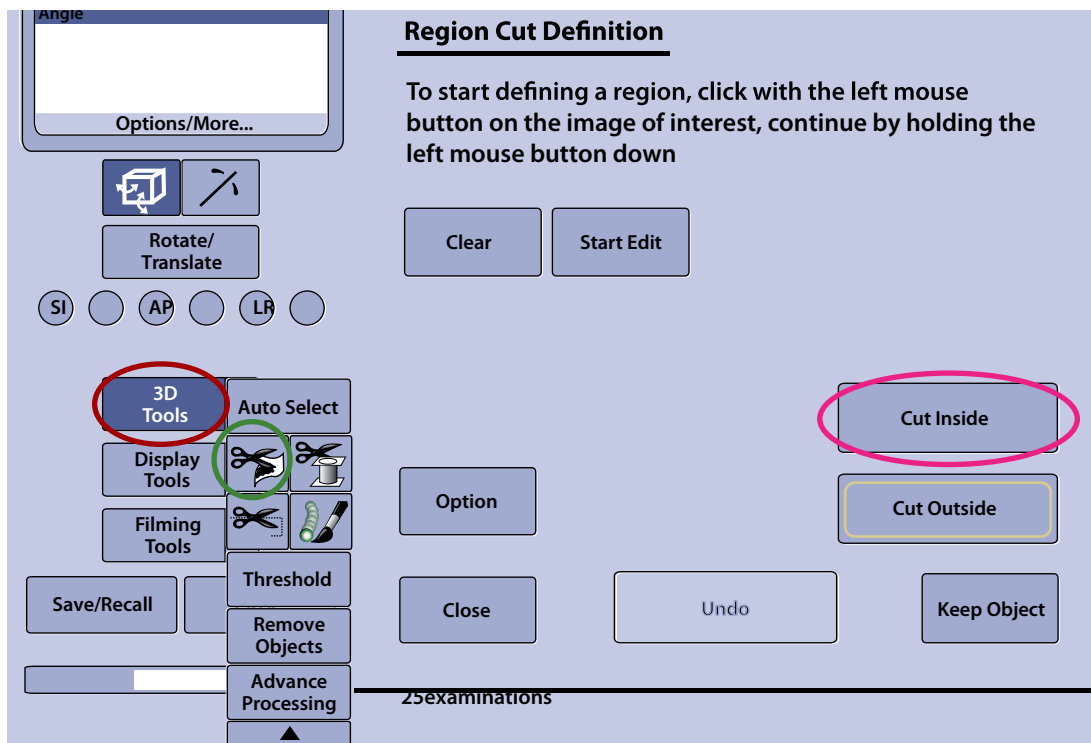


Fig 15.3 Rotating the 3D image



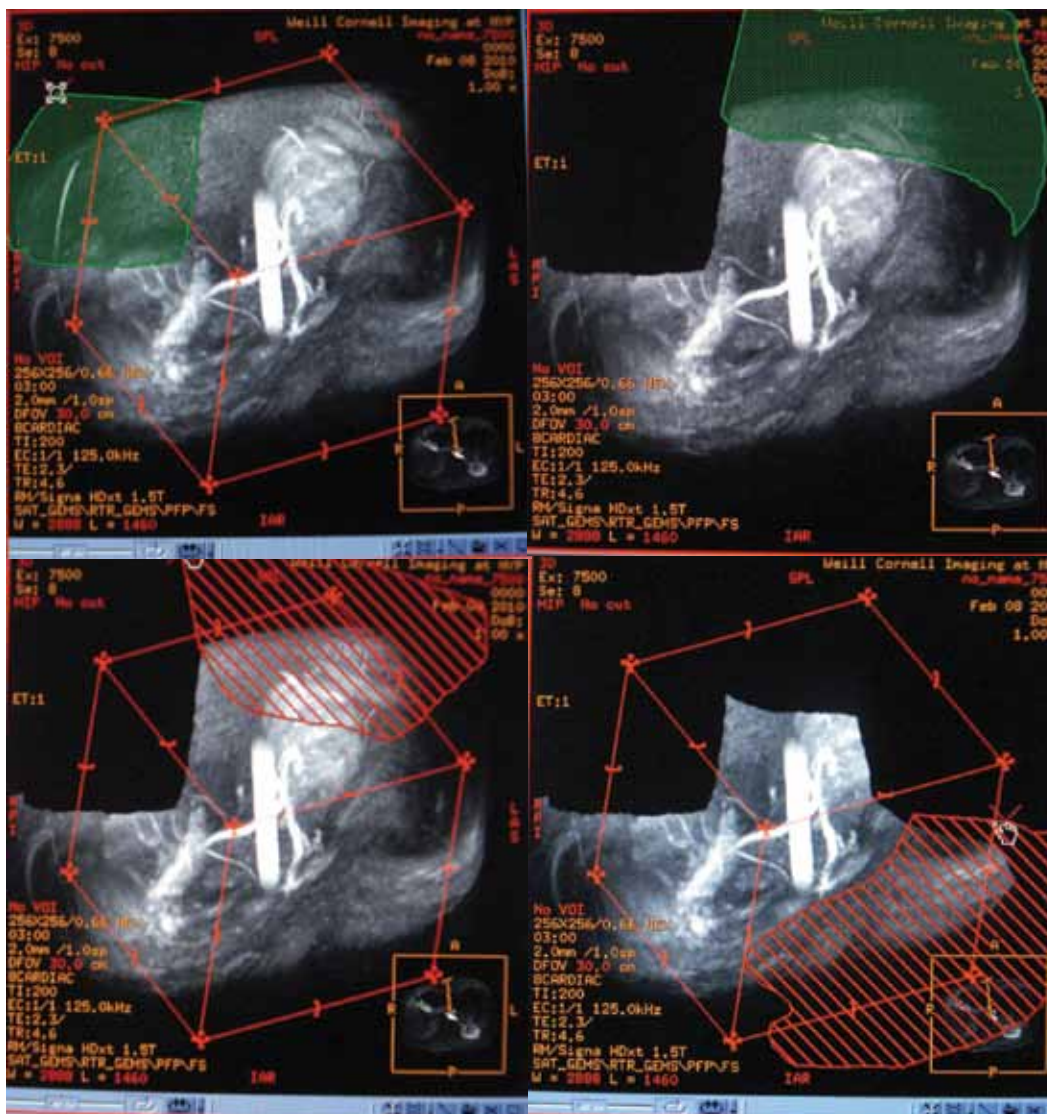
Click the **3D tools** and select the **Cutting pair of scissors tool** to start defining the region (Fig 15.4).

Fig 15.4 Region Cut Definition screen



Click on the image to start defining the region. Highlight the region that you want to eliminate using the left button of the mouse (Fig 15.5). Click **Cut Inside** to get rid of that region (Fig 15.4).

Fig 15.5 Cutting the region



On the window of the image, click the right button of the mouse and select Save Image. Click close to exit.

To retrieve the reconstructed image, go to Browser and look for PJN, the name of your new image. Click Viewer on the right side of the window to see the image.

Fig 15.6 Newly Reconstructed Renal Arteries

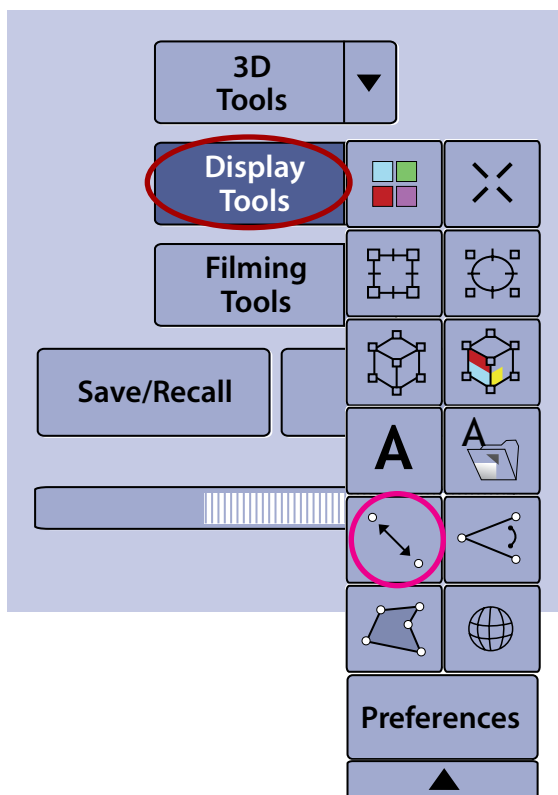


Part II: Measuring the Diameter of the Renal Artery

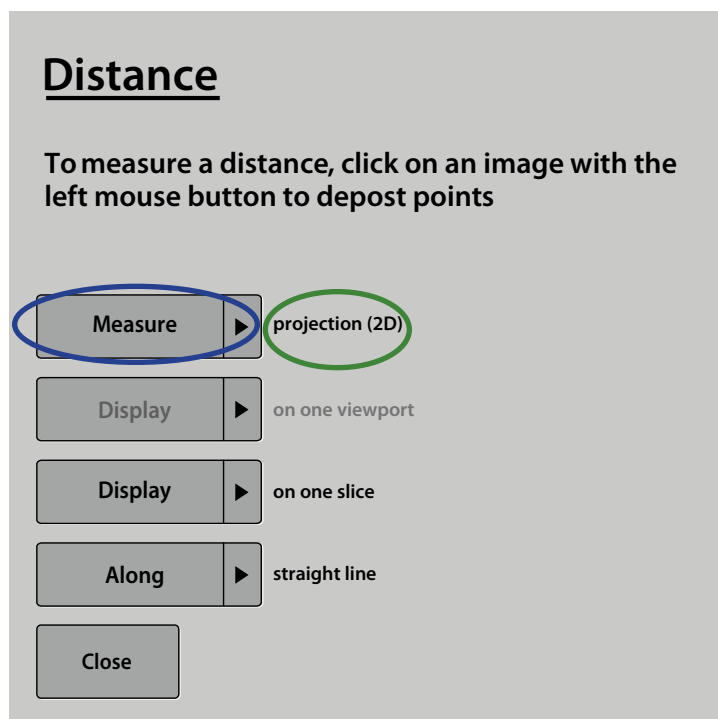
Go to Browser. Select the patient's name and the Axl 3D PC sequence then 3D MIP. Go to **Display Tools** and then click **Double arrowhead tool** (Fig 15.7a). On the Distance window, click **Measure** then **projection 2D**. Then close it to start measuring (Fig 15.7b).

Fig 15.7 Measure distance


(a) Display Tools



(b) Distance window






Click  found at the top of the Axial window screen, then start depositing the point on one side of the right renal artery to the other side of the vessel to measure the diameter (Fig 15.8). Diameter thickness will be displayed in mm.

To save the image, click the right button of the mouse and select Save Image. Click Close to exit. Do the same for the left renal artery.

Part III: Measuring Kidney Length and Parenchymal Thickness

Go to Browser. Select the patient's name and the Sagittal T1 sequence then 3D MIP. Go to **Display Tools** and then click **Double arrowhead tool** (Fig 15.7a). On the Distance window, click **Measure** then **projection 2D**. Then close it to start measuring (Fig 15.7b).



Click  found at the top of the Sagittal window screen, then choose the slice with the largest kidney by sliding the scroll bar on the side. Start depositing the point on the upper pole of the one side of the right renal artery to the other side of the vessel to measure the diameter (Fig 15.8). Diameter thickness will be displayed in mm.

Draw a line from the upper end of the kidney all the way to the lower end. Kidney length will be displayed at the bottom of the screen.

Fig 15.8 Measuring Renal Artery Diameter

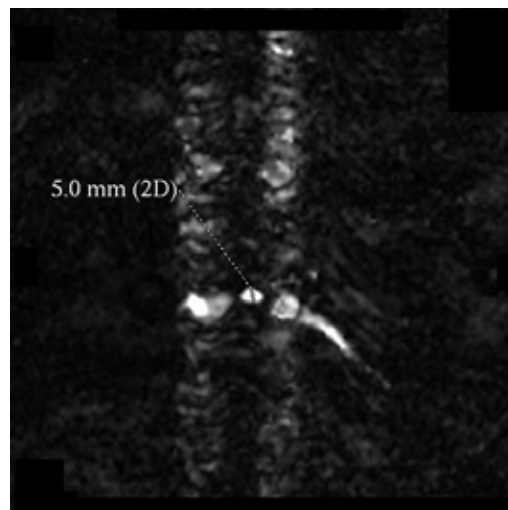


Fig 15.9 Measuring kidney length



To measure parenchymal thickness on the other hand using the same image, draw a line on the upper, mid, and lower poles (Fig 15.10). Measurement of each pole is displayed accordingly.

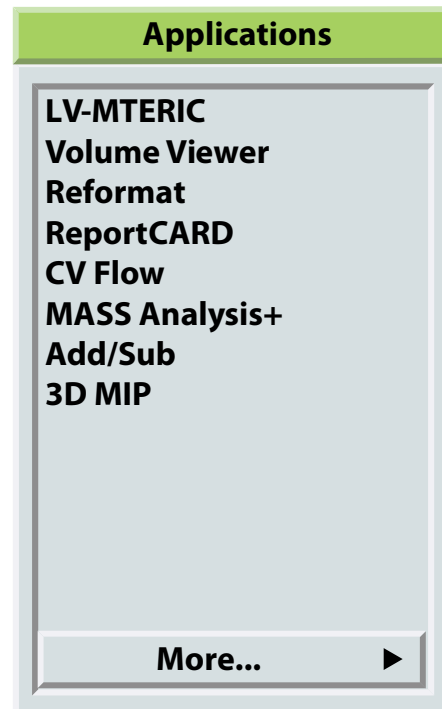
Fig 15.10 Measuring parenchymal thickness (upper, mid, and lower poles)



Part IV: Renal Artery Blood-Flow Graph

Go to Browser. Highlight the name of the patient and the Sagittal 2D Cine PC (RT) sequence, and then click CV Flow on the Applications.

Fig 15.11 CV Flow Application




Click  on the Mode section, then click on the right renal artery to automatically outline the contour of the vessel.

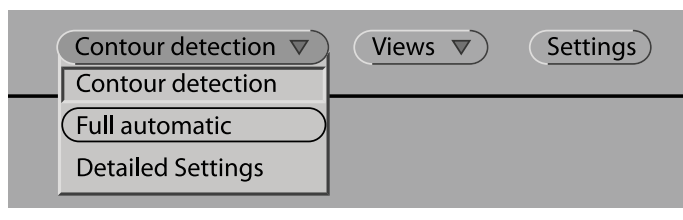
Fig 15.12 Outline vessel contour



Select Full Automatic under Contour Detection to automatically outline the contour on all the slides (Fig 15.13a). To display the blood-flow curve, click Views then select Flow Curve (Fig 15.13b).

Fig 15.12 Outline vessel contour

(a) Contour Detection



(b) Views

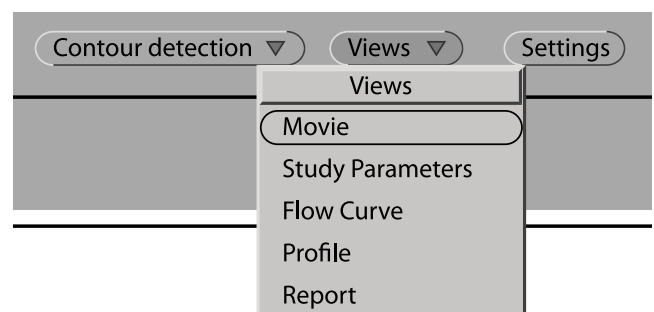
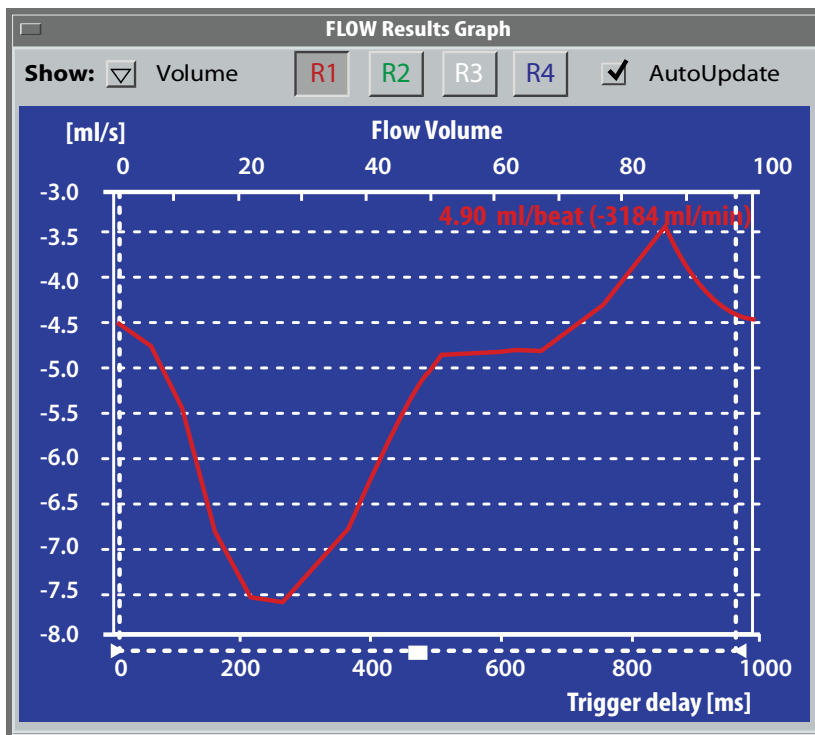


Fig 15.14 Right Renal Artery Blood-Flow Curve



The flow in ml/beat is found on the top part of the curve. Do the same for the left renal artery using the Sagittal 2D Cine PC (LT) sequence.

Suggested Readings:

http://books.google.com/books?id=T_KNSWU4uz4C&pg=PA246&dq=maximum+intensity+projection&ei=WM51S43dLqOEywSXzN1H&cd=1#v=onepage&q=maximum%20intensity%20projection&f=false

<http://cjasn.asnjournals.org/cgi/content/full/2/1/38>

<http://radiology.rsna.org/content/211/2/337.abstract>

http://www.medscape.com/viewarticle/437305_2