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REVIEW

Ventriculography in a Single Catheterization Laboratory

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Abstract

Catheter based ventriculography has evolved over the last century and in many instances has been replaced by use of cardiac ultrasound. Despite the shift, ventricular function remains an important part of assessing myocardial damage and prognosis. There is no doubt that cardiac ultrasound can evaluate LV size, myocardial wall motion and wall thickening, and is non-invasive, readily available, relatively inexpensive and portable. Poor acoustic windows are the major limitation of cardiac ultrasound as are foreshortened imaging planes. In contrast, catheter based left ventriculography, can evaluate similar attributes of LV function but limitations are that it is invasive requiring arterial access, involves radiation exposure, and the use of iodinated radio-opaque contrast which may result in renal dysfunction. The Society of Cardiovascular angiography and Intervention (SCAI) recommendations for catheter based left ventriculography are consensus opinions which need rigorous prospective evaluation. Probably the most important SCAI recommendation is that local criteria should be developed to decrease variation in performance among operators within individual catheterization laboratories. No data are available to determine which patient gets catheter based left ventriculography or echo assessment of ventricular function. Decision making regarding the use of catheter based or ultrasound based angiography is quite complex because of limitation and interaction of the various determinants, e.g. creatinine, diabetes, gender, contrast volume and fluoro time.

Keywords: Ventriculography; LV Angio; Echo ventriculography; SCAI recommendations

Introduction

In 1958, F. Mason Sones, accidentally injected radio opaque contrast into the right coronary artery instead of the aorta [1]. Sones thought he killed the patient, but he did not. Sones and Shirey developed the procedure further, and published their work in 1962. Dr. Sones thought left ventriculography was an important complimentary study to be performed with the selective coronary angiogram. I have always thought likewise. Thus, when I trained, I usually performed a power injected 30–40 cc RAO ventriculogram at the start of the procedure. This allowed assessment of anterior wall, apex and inferior wall motion, ejection fraction, degree of mitral regurgitation, LV systolic pressure and assessment of aortic valve motion. Since I was using radio-opaque contrast (Renograffin 76) that slowed the heart, and depressed LV function, (especially after coronary angiography) I did not perform an LAO ventriculogram. In current practice, radio-opaque contrast is relatively benign, so that an additional ventriculogram (LAO) can be performed that is much less detrimental to the myocardium than it was several years ago.

Data Collection

Retrospective observational reports on ventricular function from the cardiac catheterization laboratory

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and cardiac ultrasound laboratory at UF Health were collected.

Seven hundred and twenty five (725) left heart catheterizations (LHC) and coronary angiographies were performed over a period of 7 months.

Overall Performance of Ventricular Function

Of the 725 LHC patients, studied over a period of 7 months, LV angiograms were performed in 316 patients and not performed in 409 patients.

Cardiac ultrasound assessment of ventricular function was performed in 657 patients (90.6%) and not performed in 68 patients (9.4%).

Overall there were two operators out of 15 responsible for the majority (390 out of 665 patients) of LV angiograms performed.

Frequency of LV Echo and LV Angios Performed in the 725 LHC Patients

24 patients, (3.3%) did not have an LV angio or an echo assessment of LV function.

44 patients (6.1%) had an LV gram but no echo.

385 patients (53.1%) had an echo but no catheter based LV angiogram.

272 Patients (37.5%) had an echo and a catheter based LV angiogram.

Decision Making for the Type of Ventriculography

All risk factors such as diabetes, age, gender, contrast volume and creatinine are not stand alone determinants of who gets catheter based LV angiography and who does not. Decision making is far more complex because of overlap and interaction of the various determinants, plus the fact that this is a retrospective analysis of the data.

Limitations of Catheter based LV Angiography

1. Invasive Procedure

It requires arterial access, radiation exposure and iodinated contrast.

2. Radiation Exposure

Average radiation exposure for coronary angiography plus LVGram is approximately 5–7 milliSeiverts (mSv). The performance of left ventriculography may increase total radiation exposure to the patient by up to 30%.

3. Radio-Opaque Contrast Agents

Patients with chronic kidney disease, hypotension, anemia, and heart failure are at increased risk for developing contrast-induced nephropathy, defined as a rise in serum creatinine of 0.3 meq/L. This rise in serum creatinine rarely results in the need for dialysis.

Echo Assessment of LV Function

There is no doubt that Trans thoracic echo (TTE) can evaluate LV size, myocardial wall motion, and wall thickening similar to catheter based ventriculography. Most echo parameters are qualitative visual assessment of LV systolic function and are commonly reported as normal, hyperdynamic, or depressed. (Depressed function can be global or regional) Global LVEF by TEE can be reported as mildly depressed (41–51%), moderately depressed (30–40%), and severely depressed (<30%). When used in clinical practice LVEF by 2D echo visual estimation represents one of the most common methods used in each of a 16 segment model of the heart.

Advantages of Cardiac Ultrasound

1. Noninvasive,
2. Readily available
3. Relatively inexpensive
4. Portable.
5. Easily repeated,
6. No radiation exposure.
7. No Radio-opaque contrast exposure
8. Serial LV function can be assessed.

Limitations of Cardiac Ultrasound

1. Poor Acoustic Windows; may make LV evaluation difficult to obtain. This can be reduced when endocardial border definition contrast is used.

2. Quantitation; some studies have shown that quantitative assessment ot LV function by 2D TTE is suboptimal in up to 20% of patients. This can be reduced when endocardial border definition contrast is used.
3. Operator dependent; usually performed by a sonographer who does not know the patient, not by a physician who knows the history and state of the coronary artery pathology
4. Problems with regional dysfunction vs global dysfunction
5. Problems with foreshortened image plane which may result in incorrect measurements.

Discussion

In my opinion and the opinion of many others, assessment of LV function is an integral part of the coronary angiographic study since it provides data on wall motion, volume, ejection fraction, chamber size and valvular regurgitation. Having a left ventriculogram is probably the best way to risk stratify and predict the long-term outcome of patients with coronary artery disease. LHC is the only method to evaluate LVEDP, and LV systolic pressure. LV angiography can also identify regional LV wall motion abnormalities consistent with abnormalities found in the epicardial coronaries and coronary microcirculation. Ventricular thrombus can often be seen and yet may be missed on noncontrast transthoracic echo as can aneurysms, pseudo-aneurysms, and ventricular septal defects. Left ventriculography also can estimate myocardial viability by comparing a baseline cardiac cycle to one that follows a PVC, infusion of an inotrope, or by decreasing ischemia with glyceral trinitrate infusion.

The role of left ventriculography has evolved radically over the last half-century, but has received little notice in the literature. The technique and frequency of use of left ventriculography vary across regions of the United States, institutions, and individuals.

At the moment, there are no specific guidelines, from ACC, AHA, ESC or SCAI for the performance of left ventriculography at the time of coronary angiography or left heart catheterization.

Estimated cost of catheter based left ventriculography at the time of the LHC vs independent TTE– $91 vs. $189.

Recommendations by SCAI for use of Left Ventriculography [2]

1. When left ventricular function or wall motion is unknown, or mechanical disruption is suspected and results of the study will help determine therapy. (Examples include acute coronary syndromes without prior noninvasive imaging, or when an acute change in clinical status suggests left ventricular function has recently changed.)
2. Avoid LV angiography when an adequate alternative left ventricular imaging study has been performed and reviewed by the operator.
3. Avoid left ventriculography in patients for whom it creates significant risk. Examples include patients with renal insufficiency (when left ventriculography could increase the risk of contrast induced nephropathy), elevated end diastolic pressure (when left ventriculography could increase the risk of acute respiratory decompensation), known or suspected left ventricular mural thrombus, aortic valvular vegetation, and in those that have already received high levels of radiation exposure.
4. Develop local criteria for performance of left ventriculography and work to decrease variation in its performance among operators within individual catheterization laboratories.
5. Perform left ventriculography with a multisidehole catheter using a power injector.

Consensus Document

The recommendations by SCAI in their document are based on the consensus of a writing group and would be level of evidence C if they were formal guidelines. They should be tested for accuracy by clinical research studies. Until such studies are performed, the writing group believes that adoption of these recommendations will lead to a more standardized application of ventriculography and improve the quality of care provided to cardiac patients.

Conclusion

All things considered, I favor catheter based angiography unless there is serious contraindication, to use of contrast, spelled out in the catheterization report by the operator. Unfortunately the volume of contrast used is measured after the case is concluded. This concern can be eliminated if the ventriculogram is done at the beginning of the procedure. If echo is used to assess LV function then the operator should be aware of the quality of the echo and the findings of ventricular function at the time of the LHC and before the patient leaves the catheter laboratory. The problem with both methods of assessing LV function is quantitation and interobserver variation.

Questions that Remain

1. Why is there so much difference in the performance of LV angiography at the time of the cardiac catherization?
2. Why was a catheter based LV gram or echo LV gram, not done in 24 patients?
3. How many of the patients who had an echo done and no LV gram, were the echoes acceptable to evaluate LV function?
4. When was the echo performed, i.e. before, during or after the coronary angiogram,
5. Was the echo compared to the known Coronary artery disease distribution of LV dysfunction?
6. How often do patients have poor acoustic windows on TTE?
7. How often is contrast necessary because of poor acoustic windows?
8. How often is contrast necessary to determine LV function by echo
9. How often is creatinine elevated after contrast?
10. Has increased fluoro time ever resulted in skin burns?

REFERENCES

1. Sones FM Jr, Shirey EK. Cine-coronary arteriography. Mod Concepts Cardiovasc Dis 1962;31:735–8.
2. Gigliotti OS, Babb JD, Dieter RS, Feldman DN, Islam AM, Marmagkiolis K, et al. Optimal use of left ventriculography at the time of cardiac catheterization: a consensus statement from the Society for Cardiovascular Angiography and Interventions. Catheter Cardiovasc Interv 2015;85:181–91.