

Simultaneous Measurement of Differential Pressures With a Dual Lumen Catheter

Using a dual lumen catheter to accurately measure pressures between two sites across a valve or stenosis.

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Aortic stenosis is one of the most common valvular problems in the developed world.¹ Along with an aging population, the prevalence of aortic stenosis is expected to increase in the future. Although patients can be asymptomatic in early stages of the disease, symptoms that may be present, especially in patients with a severe aortic stenosis, include shortness of breath; chest pain (angina), pressure, or tightness; and fainting.

Once symptoms are present, the prognosis is poor unless aortic valve replacement is performed promptly.² Before undergoing treatment, these patients can be examined with the Langston Dual Lumen Catheter from Teleflex, which measures simultaneous pressures across the aortic valve to help clinicians determine the pressure gradient and effective orifice area (EOA) (Figure 1).

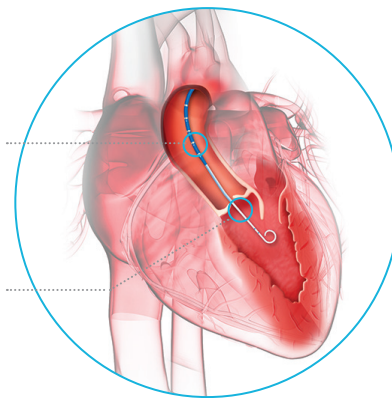


Figure 1. Placement of Langston Dual Lumen Catheter for simultaneous measurement of differential pressures.

(ultrasound) can show a thickened, calcified aortic valve that opens poorly. Doppler flow can be used to determine the pressure difference on either side of the aortic valve and to estimate the EOA, but it is not always accurate, depending on the skill of the operator and the anatomy of the patient.

Cardiac Catheterization

Cardiac catheterization assists in determining the severity of a valvular stenosis by directly measuring the pressure gradient and flow across the valve. In patients with aortic stenosis, a true transvalvular pressure gradient is strongly recommended before valve

replacement.

Any catheter designed for ventricular entry can obtain a left ventriculogram and measure the pressure within the left ventricle (LV). However, the Langston Dual Lumen Catheter can simultaneously measure the pressure in the aorta and the LV.

There are several ways that a pressure gradient may be measured across the aortic valve in a catheterization procedure:

Pullback method. A single-lumen pigtail catheter first measures the LV pressure before a “pullback” of the catheter into the aorta to measure the pressure in the aorta. Measurement is not simultaneous because each is taken during different cardiac beats, which can change the pressures.

Double stick method. Puncturing both groins or radial arteries and placing two pigtail catheters—one in the LV

DIAGNOSTIC OPTIONS FOR AORTIC STENOSIS

Noninvasive Tests

Abnormal patterns on an electrocardiogram can reflect a thickened heart muscle and suggest the diagnosis of aortic stenosis. A transesophageal echocardiogram, due to the relative proximity to the heart, is more accurate than a standard external echocardiogram, but it requires esophageal anesthetic, conscious sedation, and a brief outpatient stay.

A chest x-ray can show whether the heart shadow is normal or enlarged. Careful inspection of a chest x-ray sometimes reveals calcification of the aortic valve, but not the extent of the stenosis. An echocardiogram

and one in the aorta. This technique produces accurate simultaneous aorta and LV pressures, but requires bilateral femoral or radial artery punctures, plus the additional introducer sheath, guidewire, and pigtail catheter.

Sidearm of a short sheath. Using a single-lumen pigtail catheter to measure the LV pressure while using the sidearm of the introducer sheath to measure the aortic pressure. This method may be subject to mistaken readings if there is any iliac or aortic stenosis, which would affect the sidearm pressure reading. Although measuring the gradient between the LV and the femoral artery is convenient, downstream augmentation of the pressure signal and delay in pressure transmission between the proximal aorta and femoral artery may alter the pressure waveform and introduce errors.

Sidearm of a long sheath. Using a single lumen pigtail to measure the LV pressure while using the sidearm of a long introducer sheath to measure the aortic pressure. While this technique can yield positive results it can be difficult and dangerous to run a long sheath through the aorta.

Transseptal Approach. This technique involves a venous approach via a puncture of the ventricular septum with a needle followed by advancement of a catheter into the LV. An additional catheter is placed in the aorta and measures simultaneous pressures at the aortic root. This invasive technique is better suited for patients with mechanical aortic valves due to the desire to avoid placing anything across the mechanical valve.

WHY IS ACCURACY SO IMPORTANT?

Because the aortic valve gradient is one of the key measurements used to determine the EOA, which then determines whether valve replacement is performed, it is very important to accurately measure pressures. Physicians need to be precise in their diagnostic measurements. The Langston Dual Lumen Catheter, which is designed to simultaneously and accurately measure the pressure gradient across the aortic valve (AV), can help determine the degree of aortic stenosis.

CASE REPORT: LANGSTON DUAL LUMEN CATHETER IN USE

A 91-year-old woman was referred to the Rechts der Isar Hospital with progressive shortness of breath and angina at rest for several days. Midsystolic murmur was detected during clinical examination.

Course of treatment

Noninvasive testing with electrocardiogram and echocardiogram showed left ventricular thickening and severe aortic valve stenosis. The patient was then referred to the cardiac catheterization lab to precisely stage the severity of the underlying aortic valve stenosis. A sheath was introduced into the right radial artery and an AL1 catheter was placed above the aortic valve. A straight wire was used to pass the stenotic aortic valve, and the AL1 catheter was advanced into the LV. A J-shaped 0.035-inch wire was then introduced into the LV and the AL1 catheter was removed. The Langston Dual Lumen Catheter was placed into the LV, and simultaneous aortic and ventricular pressure measurements were obtained.

Results

Due to the simultaneous pressure measurement, a direct and accurate evaluation of the peak-to-peak gradient (62 mm Hg) and mean gradient (60 mm Hg) over the aortic valve was found, indicating a high-grade



Figure 2. Simultaneous measurement of pressure gradients showed a peak-to-peak gradient of 62 mm Hg, and a mean gradient of 60 mm Hg.

aortic stenosis (Figure 2). Finally, angiography with the Langston Dual Lumen Catheter in the LV showed good LV function.

Discussion

Accurate and reliable diagnosis and staging of a high-grade symptomatic aortic stenosis was enabled in this case using the Langston Dual Lumen Catheter. Our patient was consequently referred to undergo a successful transcatheter aortic valve replacement.

TIPS FOR USE: LANGSTON DUAL LUMEN CATHETER

- Flush both lumens with a heparinized saline solution, and turn the stopcock to a closed position before inserting the catheter into the introducer sheath. If blood is drawn into either lumen, flush lumen immediately to avoid clot formation.
- Flush thoroughly and often to remove any air bubbles that may be trapped in the device. Flush the Langston Dual Lumen Catheter before deployment as well as once it is in the heart and to pull the wire (air can be sucked into the system if the wire is removed too quickly).
- When placed appropriately, the sidearm measures the pressure proximal to the valve. The pigtail and multipurpose catheters have a marked "AO" tag on the sidearm to remind the user that it is the aortic pressure.
- Transducers should be placed at the same height and the same distance from the heart.
- The Langston Dual Lumen Catheter should be normalized/zeroed out prior to crossing the valve to ensure that both lumens are measuring at the same level before beginning to take pressures across the valve.
- Contrast can impact the measured pressure. If an LV angiogram is taken before pulling back, pressure readings may be affected. Flush after all contrast injections.
- The sidearm is not designed for power injections and they should not be performed. The tag on the sidearm provides a reminder.

THE LANGSTON DUAL LUMEN CATHETER

Langston Dual Lumen Catheters are angiographic catheters with a two-lumen coaxial-design (Figure 3). The inner lumen extends the entire length of the catheter and can be used for pressure measurements and power injections. The inner lumen is a standard braided catheter and has an injection pressure rating suitable for Medrad or ACIST injections. The outer lumen terminates 3 to 15 cm (depending on the version) proximal to the distal end of the catheter and has a series of sideholes for pressure measurement. The outer lumen has a clear sidearm and three-way stopcock on the proximal end. This lumen is for pressure measurement only and cannot withstand high pressure injections. A tag on the sidearm states this warning.

Deployment

The Langston Dual Lumen Catheter records the pressure gradient simultaneously using its coaxial design (a lumen within a lumen). The inner braided lumen extends the entire length of the catheter and is positioned in the LV. The catheter tip and multiple sideholes of the inner lumen allow for safe delivery of contrast medium and the transmission of pressures. The outer lumen ends proximal to the distal end of the catheter and is positioned on the proximal side of the aortic valve in the aorta. Although not designed for high pressure injections, the multiple side holes on the outer lumen allow for accurate pressure transmission. The coaxial design allows the pressures from both sites to be simultaneously measured via external transducers. ■

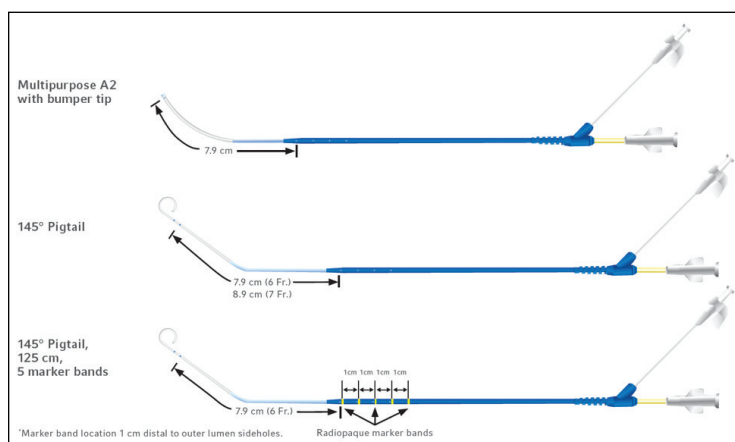


Figure 3. Available Langston configurations.

Indications for Use

Each Langston Dual Lumen Catheter is indicated for delivery of contrast medium in angiographic studies and for simultaneous pressure measurement from two sites. This type of pressure measurement is useful in determining transvalvular, intravascular and intraventricular pressure gradients.

Contraindications

The Langston Dual Lumen Catheter is contraindicated for use in:

- synthetic vascular grafts
- artificial heart grafts

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Refer to the Instructions for Use for a complete listing of the indications, contraindications, warnings and precautions. Langston Dual Lumen Catheters are not available in all regions. Please contact customer service to confirm availability in your region.

1. Manning WJ. Asymptomatic aortic stenosis in the elderly: a clinical review. JAMA. 2013;310:1490-1497.
2. Otto CM, Prendergast B. Aortic-valve stenosis—from patients at risk to severe valve obstruction. E Engl J Med. 2014;371:744-756.



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Disclosures: Lecture fees from Bayer HealthCare, AstraZeneca GmbH, and Bristol-Myers Squibb; writing honorarium from Teleflex.