PV Catheter Positioning Guide

How to Ensure Proper Catheter Placement for Accurate Volume Measurements

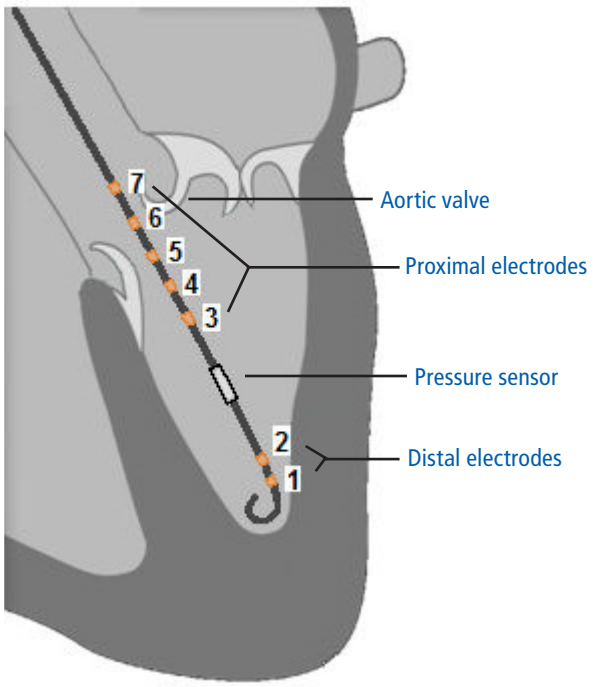
VIEWING THE PRESSURE VS. MAGNITUDE LOOPS AND PHASE SIGNAL DURING CATHETER POSITIONING IN THE VENTRICLE CAN ASSIST IN PROPER PLACEMENT.

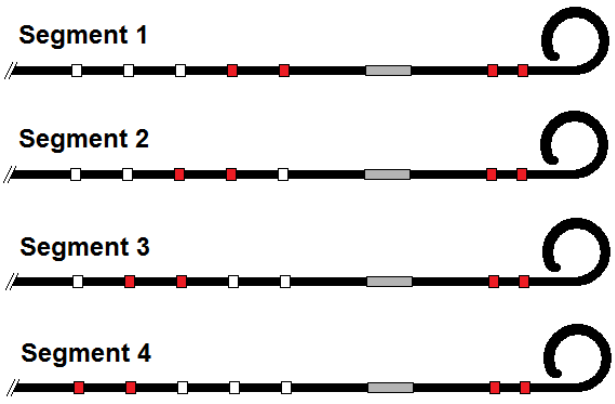
Correct placement of the Catheter in the ventricle is important for accurate data collection. Always use care when inserting the Catheter past the aortic valve as excessive force can cause Catheters damage, especially in small, rodent Catheters. Variable Segment Length (VSL) Catheters have four segment length settings. Select the longest segment length that gives physiological shaped pressure vs magnitude loops. The typical range of magnitude values for healthy animals with the specified body weights and stroke volumes are as shown:

SPECIES	BODY WEIGHT	STROKE VOLUME (SV)	MAGNITUDE |Y| VARIATION
Mouse	20 - 25 g	18 - 23 µL	≥ 200 µS
Rat	300 - 400 g	270 - 360 µL	≥ 500 µS
Pig	35 - 45 kg	30 - 40 mL	≥ 2.5 mS

If using a VSL Catheter start with the shortest segment length (segment 1) for initial insertion.

The phase signal allows you to visualize the proximity of the Catheter to the heart wall and can help in Catheter placement. The signal should be periodic in shape with a relatively low mean value (< 10°). Position the Catheter for the lowest mean phase signal (center of the LV). If the phase signal is excessively noisy, try repositioning the Catheter slightly or remove any sources of interference that may be attached to the animal.





Four selectable segment lengths (active rings in red). Segment 1 is the shortest (for smaller hearts) while segment 4 is the longest (for larger hearts). The distal electrode pair (1 & 2) remain the same for all segments.

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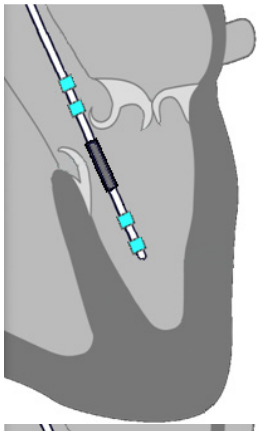
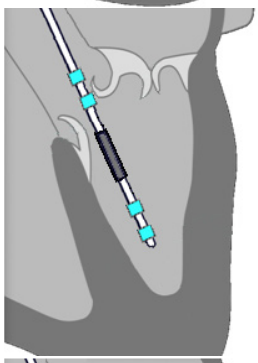
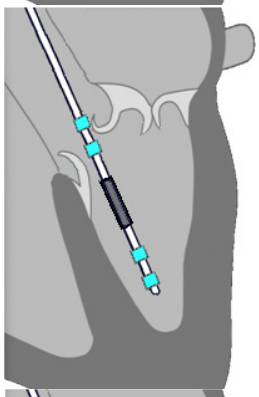
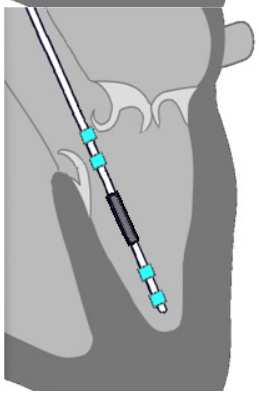








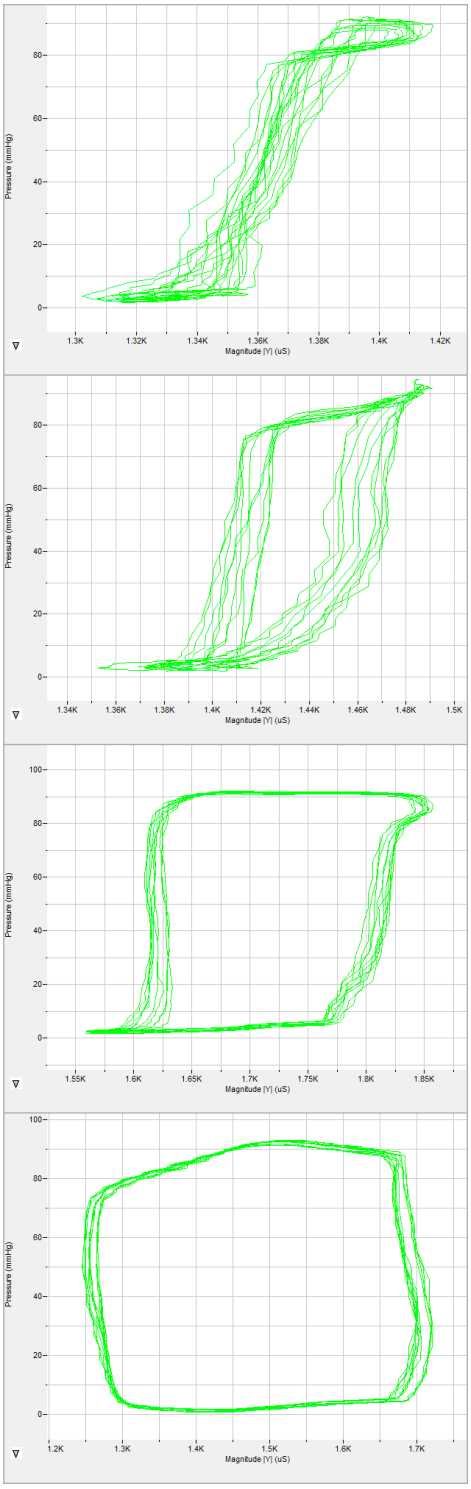
The evolution of pressure vs magnitude loops as the Catheter is inserted into the left ventricle from the aorta follows:

1. Pressure sensor is in the LV, just past the aortic valve. The two distal volume electrodes are in the LV. The two proximal electrodes are in the aorta.

2. Pressure sensor is in the LV, just past the aortic valve. The two distal volume electrodes are in the LV. The two proximal electrodes are in the aorta, very close to the aortic valve.

3. Pressure sensor is in the center of the LV. The two distal volume electrodes are in the LV. The two proximal electrodes are on either side of the aortic valve.
   - If the Catheter is too long for the ventricle size being studied, this may be the best position possible. If available, a smaller Catheter should be used instead.

4. Pressure sensor and volume rings are completely inside the LV. The most proximal electrode is situated very close to the aortic valve in the LV.
   - This is the ideal Catheter position.
   - Once the ideal depth has been determined, check the phase signal to ensure the Catheter is appropriately centered in the ventricle.



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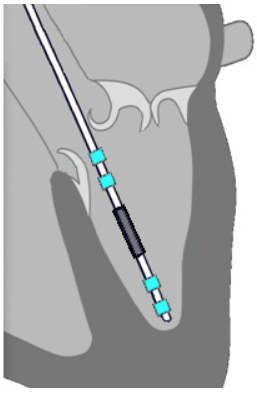
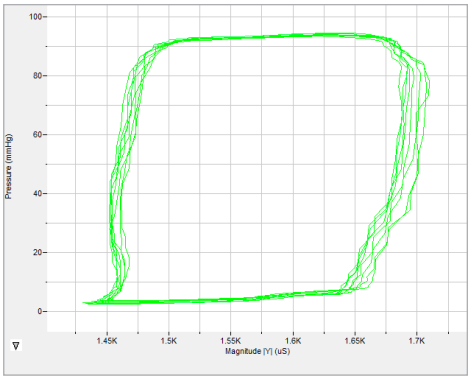
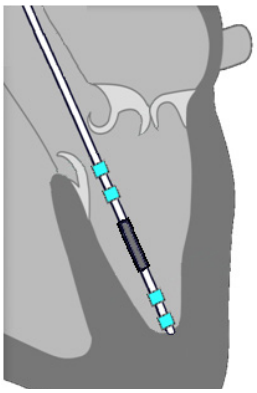
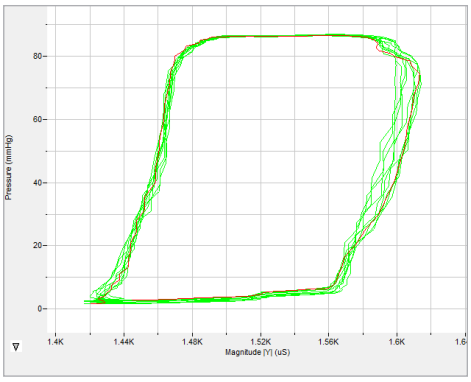


5. Catheter tip is very close to the apex. The distal electrodes almost touch the apex.
   - This Catheter position is acceptable. During IVC occlusions, the proximal electrodes could be pushed out of the LV into the aorta.

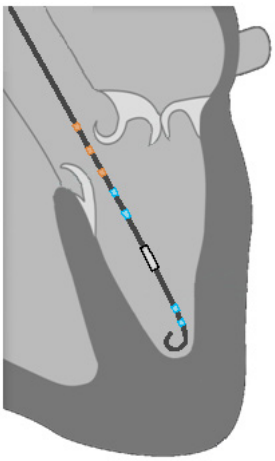




6. Catheter is jammed into the apex. The |Y| variation is low (≈ 100µS)
   - Non-ideal position and must be avoided if possible. This position causes premature ventricular contractions (PVC) in rats and large animals.

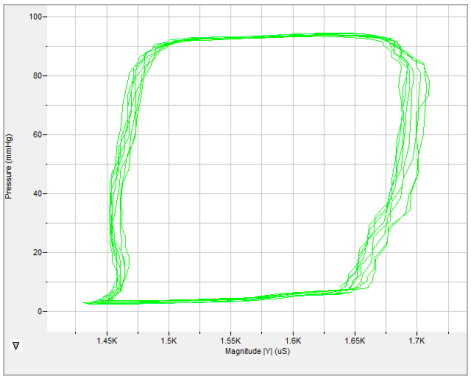


Once the Catheter is fully inserted, segment size can be adjusted on VSL Catheters. Increase the segment length one size at a time and observe the shape of the loops. Continue increasing the spacing until the shape of the loops no longer appears physiological. Then return to the previous segment. The following is an illustrative example of segment selection:



SEGMENT 1 ACTIVE ELECTRODES: 1, 2, 3, 4

- Selected segment is too short for the LV
- The shape of the Pressure vs. Magnitude loops look physiological
- Calculated volumes will be low due to missing volume at the base of the heart (near the valve)
- Select segment 2



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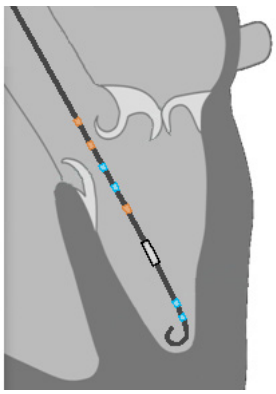
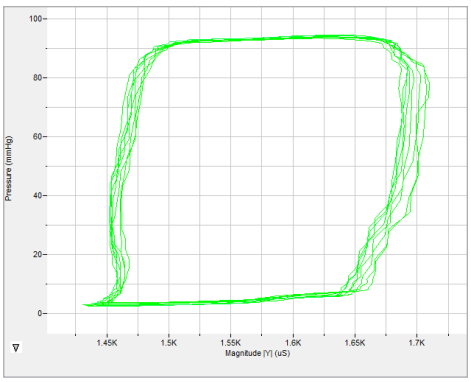
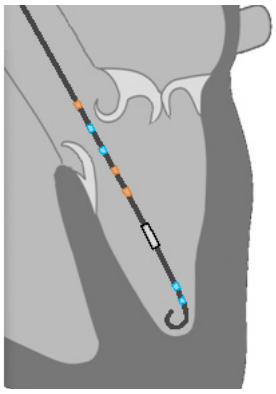


SEGMENT 2 ACTIVE ELECTRODES: 1, 2, 4, 5

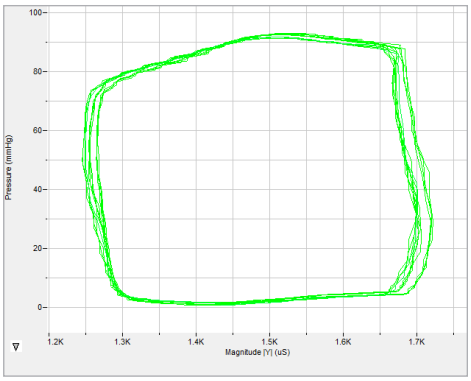
- Selected segment is too short for the LV
- The shape of the Pressure vs. Magnitude loops look physiological
- Calculated volumes will be low due to missing volume at the base of the heart (near the valve)
- Select segment 3

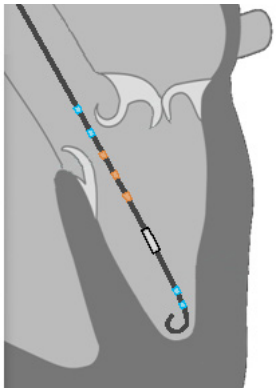




SEGMENT 3 ACTIVE ELECTRODES: 1, 2, 5, 6

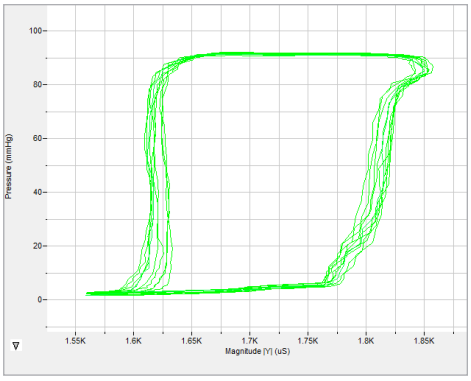
- Selected segment is the ideal length for the LV
- The shape of the Pressure vs. Magnitude loops look physiological
- Calculated volumes will be accurate
- Select segment 4





SEGMENT 4 ACTIVE ELECTRODES: 1, 2, 6, 7

- Selected segment is too long for the LV
- The shape of the Pressure vs. Magnitude loops appears distorted
- Calculated volumes will be inaccurate
- Select segment 3 since it is the appropriate segment length for the LV



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