# Hemodynamic effects of vacuum-assisted closure therapy in cardiac surgery, assessment using real time magnetic resonance flow quantification

**M. Ugander[1], R. Petzina[2], L. Gustafsson[2], H. Engblom[1], J. Sjogren[3], R. Hetzer[4], R. Ingemansson[3], H. Arheden[1], and M. Malmsjo[2]**

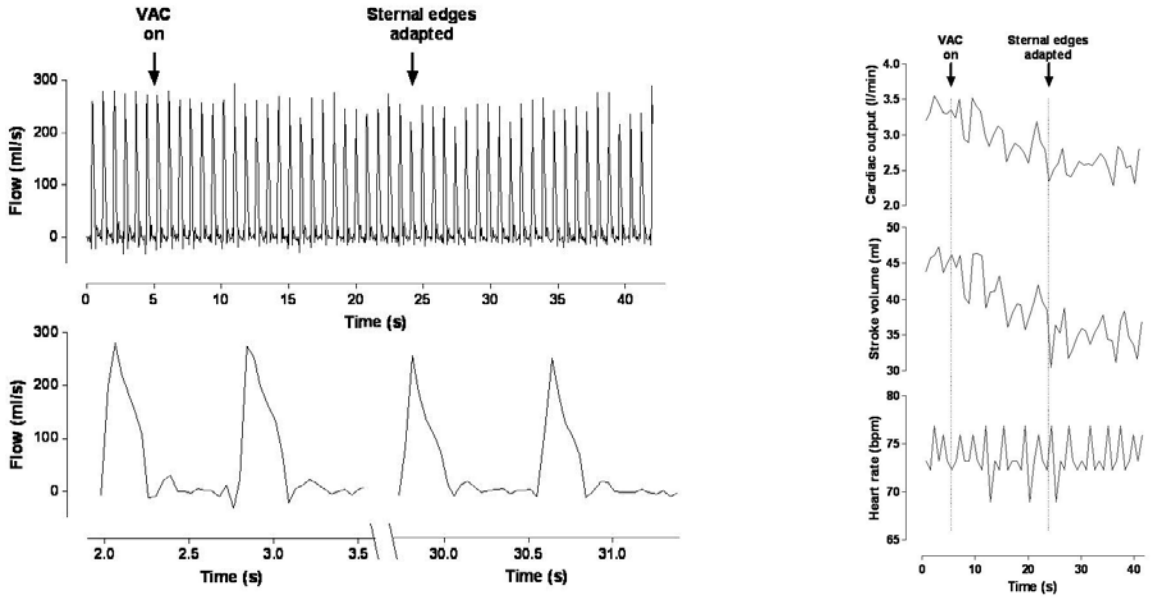
[1]Clinical Physiology, Lund University Hospital, Lund, Sweden, [2]Medicine, Lund University Hospital, Lund, Sweden, [3]Cardiothoracic Surgery, Lund University Hospital, Lund, Sweden, [4]German Heart Institute, Berlin, Germany

**BACKGROUND.** The hemodynamic effects of vacuum-assisted closure (VAC) therapy in cardiac surgery are debated. The aim of the present study the effects of VAC upon cardiac output and left ventricular chamber volumes using magnetic resonance imaging (MRI).

**METHODS**. Six pigs underwent median sternotomy followed by VAC treatment in the presence and absence of a paraffin gauze interface dressing. Cardiac output and stroke volume were examined using MRI flow quantification (breath hold and real-time) (Philips 1.5T Intera). Imaging parameters for real-time flow acquisition were: ECG triggering = no, acquired spatial resolution = 3.4 x 3.5 x 12 mm, TR = 20.6 ms, TE = 6.8 ms, velocity encoding gradient = 150 cm/s, SENSE factor = 2.5, EPI factor = 37, duration of acquisition = 44 s. The accuracy of this novel real-time flow sequence was validated in a continuous flow phantom. Chamber volumes were assessed using cine MRI.

**RESULTS**. Cardiac output and stroke volume decreased immediately after application of negative pressures of 75, 125 and 175 mmHg (13 ± 1% decrease in cardiac output). Interposition of four layers of paraffin gauze dressing over the heart during VAC therapy resulted in a lesser decrease in cardiac output (8 ± 1%). The accuracy of the real-time flow sequence was (mean±SD) 0.7 ± 3.0% compared to phantom measurements with beaker and timer.

**CONCLUSIONS**. VAC therapy results in an immediate decrease in cardiac output, although to a lesser extent than shown previously. Covering the heart with a wound interface dressing lessens the hemodynamic effects of VAC.




**Figures.** The **left** figure illustrates the results from one experiment during the application of -175 mmHg in a sternotomy wound without interface dressing. Real time MRI flow quantification in the ascending aorta throughout 42 seconds of the application of VAC (**top panel**). "VAC on" denotes when the vacuum source was turned on and "sternal edges adapted" denotes when the lateral movement of the sternal edges was completed which presumably reflects the completion of VAC application. The **bottom panel** is a magnification of the flow in the top panel during representative heart beats. The first two beats (duration = 1.5 seconds) show representative flow prior to the application of VAC. The second two beats (duration = 1.5 seconds) show representative flow after the completion of VAC application, showing a reduced area under the curve compared to the bottom left panel, indicating a reduced stroke volume. This data is the basis for the results presented in the right panel.

The **right** figure shows changes in cardiac output (top), stroke volume (middle) and heart rate (bottom) measured using real-time magnetic resonance imaging flow quantification, during the application of -175 mmHg in a sternotomy wound without interface. dressing. "VAC on" denotes when the vacuum source was turned on and "sternal edges adapted" denotes when the lateral movement of the sternal edges was completed which presumably reflects the completion of VAC application. Note how the cardiac output and stroke volume declined during the application of negative pressure, and then seemed to stabilize.