Adequate myocardial protection is the prerequisite of a safe and successful open heart operation. Retrograde cardioplegia perfusion is thought to be a popular method of myocardial protection in recent years, and its efficacy and safety have been improved. However, the pressure waveform of the coronary sinus might help in identifying the correct cannulation site.

Methods. The pressure waveform of the coronary sinus is usually recorded by inserting a catheter into the coronary sinus, which is then connected to a pressure transducer. In this study, a catheter was inserted into the coronary sinus under direct vision via a right atriotomy after completion of open heart surgery in eight patients. The pressure waveforms of the coronary sinus and central venous line were recorded simultaneously after the patient was weaned from cardiopulmonary bypass.

Results. The pressure waveform of the coronary sinus was found to have three peaks, more prominent than those of the central venous line. The difference could help in identifying the correct cannulation site for retrograde cardioplegia perfusion.

Conclusions. The pressure waveform of the coronary sinus could be distinguished from that of the central venous line. The difference might help in identifying the correct cannulation site for retrograde cardioplegia perfusion.
Methods

This study was approved by the Human Research Committee of Taipei Veterans General Hospital and was conducted in accordance with local ethical standards. This study involved eight patients who underwent open heart surgery in Veterans General Hospital-Taipei between 1997 and 1998. Five of the patients were male and three were female, aged from 4 to 81 years (Table 1). Three patients (1, 2, and 3) received coronary artery bypass grafting (CABG) operation for stenotic coronary artery disease. Retrograde coronary sinus cardioplegia perfusion under direct vision was used due to high degree (90%) stenosis of the left main coronary artery (patient 1) or the left anterior descending coronary artery (patients 2 and 3). Two patients (4 and 5) underwent repair of atrial septum defect via right atriotomy. Two patients (6 and 7) received repair of ventricular septal defect through right atriotomy approach. Patient 8 received aortic valve replacement for critical aortic stenosis and severe aortic regurgitation. Bi-caval cannulation and right atriotomy were performed in all eight patients. All patients received either a central venous catheter (ARROW, International, Inc., Reading, PA, USA) or a Swan-Ganz balloon catheter (ARROW, International, Inc., Reading, PA, USA) for central venous pressure monitoring during the operation.

Table 1. Clinical characteristics of patients

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (year)</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67</td>
<td>Male</td>
<td>CAD</td>
<td>CABG</td>
</tr>
<tr>
<td>2</td>
<td>67</td>
<td>Male</td>
<td>CAD</td>
<td>CABG</td>
</tr>
<tr>
<td>3</td>
<td>81</td>
<td>Male</td>
<td>CAD</td>
<td>CABG</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Female</td>
<td>ASD</td>
<td>ASD Repair</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>Female</td>
<td>ASD</td>
<td>ASD Repair</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
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<td>VSD</td>
<td>VSD Repair</td>
</tr>
<tr>
<td>7</td>
<td>18</td>
<td>Female</td>
<td>VSD</td>
<td>VSD Repair</td>
</tr>
<tr>
<td>8</td>
<td>63</td>
<td>Male</td>
<td>AS</td>
<td>AVR</td>
</tr>
</tbody>
</table>

AS = aortic stenosis; ASD = atrial septal defect; AVR = aortic valve replacement; CABG = coronary artery bypass grafting; CAD = coronary artery disease; VSD = ventricular septal defect.

Results

No mortality or morbidity occurred in this study. Three peaks in the pressure waveform of coronary sinus were observed in these eight patients (Fig. 2 and Fig. 3). The first peak appeared after the “p” wave of EKG, signaling atrial contraction. The second peak coincided with T-wave in the EKG, representing ventricular contraction and atrial filling. The third peak was found to interpose between these two peaks, imme diately after the QRS complex in the EKG. There were, however, only two peaks in the pressure waveform of the central venous line. The first peak also ap-

![Fig. 1. The catheter was inserted into the coronary sinus under direct vision via a small stab within a purse-string suture in the right atrium after completion of the operation. (IVC = inferior vena cava, SVC = superior vena cava).](image-url)
peared after the “p” wave in the EKG, and the other peak appeared after QRS complex. These two peaks were much flatter and less evident than those in the pressure waveform of the coronary sinus.

**Discussion**

The pressure waveform of coronary sinus in human hearts has never been described before. Gensini and his associates introduced a cardiac catheter to pass into the coronary sinus via the right jugular vein with conventional catheterization techniques in 75 dogs. The pressure waveform of coronary sinus in these dogs was found to be composed of evident “a”, “c”, and “v” waves, similar to our findings in human. Faxon and his associates showed the pressure tracing of the coronary sinus in 27 patients on acute occlusion by March 2001.

**Fig. 2.** The recordings of ECG, pressure waveforms of coronary sinus and central venous line of patient 1, a 67-year-old male with coronary artery disease and stenosis of the left main coronary artery. (CSP = coronary sinus pressure, CVP = central venous pressure).

**Fig. 3.** The recordings of ECG, pressure waveforms of coronary sinus and central venous line of patient 7, a 18-year-old female with perimembranous type ventricular septal defect. (ABP = arterial blood pressure, CSP = coronary sinus pressure, CVP = central venous pressure).
balloon in flation of balloon-tipped catheter. An initial early systolic peak and a later higher systolic peak occurred at the end of systole and were closely timed with the “v” wave in the pulmonary wedge tracing. The measured pressure of the second peak in their study was about 43 mmHg, significantly higher than our measurement. How ever, their pressure tracing of the coronary sinus was done in conditions of coronary sinus occlusion, which could cause deviation from the normal beating heart condition.

It is not understood why “c” wave was not discernible in the pressure tracing of central venous line in our study, as it has occasionally been identified in previous reports. Right ventricle contraction elevating the cusps of the tricuspid valve, coronary veins emptying into the right atrium, and a temporary rise in intra-thoracic pressure caused by ventricular ejection have been suggested to be the origin of the “c” wave of jugular venous pulse. We surmised that the open chest condition might ob scure the “c” wave because the pressure tracing of the coronary sinus pressure wave form in detail. With more experience gained, the surgeons may intubate the coronary sinus for retrograde cardioplegia in patients undergoing myocardial revascularization: a prospective randomized trial. Ann Thorac Surg 1988;45:595-602.

References


