R
esternotomy is a common, albeit challenging, compo-
nent of many current cardiac operations and remains a
source of morbidity and mortality.1-3 Despite the re-
cent emphasis on primary repair for congenital heart
defects, complete repair or palliation often requires multiple op-

erations. In the vast majority of cases, sternal reentry can be
performed without difficulty. However, a small number of patients
have anatomic configurations that make sternal reentry particularly
hazardous. Potentially difficult sternotomies on occasion require
alternate cannulation sites. Typically the femoral vessels are used
in larger patients, but these vessels are often unavailable in pedi-

atric patients because of multiple previous cardiac catheterizations,
cutdowns, and, in pretoddler infants, inadequate size. The aim of
this report is to describe our experience with cervical cannulation
in infants undergoing resternotomy.

Methods

Patients. Six patients have undergone cervical cannulation at
two different institutions (2 at University of California Davis
Medical Center, Sacramento, Calif, and 4 at Children’s Hospital of
Michigan, Detroit, Mich). One child had only the common carotid
artery cannulated, with venous drainage from the right atrium. The
remaining patients had both the right common carotid artery and
right internal jugular vein cannulated. The diagnoses and indica-
tions for an alternative cannulation site are shown in Table 1.

Technique. Patients were placed on the operating room table
in a supine position, with the head facing to the left. A bump was
placed under the shoulders to increase cervical extension, and
surgical drapes were placed slightly cephalad.

A transverse cervical incision was made over the right sterno-
cleidomastoid muscle, parallel to and approximately 1 to 2 cm
above the clavicle (Figure 1, A). The dissection was performed
between the sternal and clavicular heads of the sternocleidoma-
toid muscle. A Weitlander retractor was sufficient for exposure
(Figure 1, B). The internal jugular vein and the common carotid
artery were dissected out. After heparinization, polypropylene (5-0
or 6-0) purse-string sutures were then placed on both the internal
jugular vein and common carotid artery (Figure 1, C). Our pref-
erence is to cannulate the common carotid artery first, followed by
internal jugular venous cannulation, but some groups prefer to
perform the venous cannulation first. The venous cannula was
positioned so that the tip lay within the right atrium. Once bypass
was established and the chest was opened, a second venous can-
nula was usually placed into the interior vena cava or within the
right atrium to augment venous return. Decannulation was per-
formed by tying the purse-string sutures.

Results

All 6 patients survived the operation. Three patients underwent
cervical cannulation prophylactically before resternotomy because
of particularly hazardous anatomy. The remaining 3 patients were
placed on bypass after bleeding was encountered during sternal
opening. In each case, the bleeding was controlled by digital
pressure by the assistant while the surgeon cannulated the cervical
vessels. Three patients have had a follow-up Doppler study of their
cervical vessels from 6 months to 2 years after surgery. In each
case, all vessels were patent. No complications have been attrib-
uted to cervical cannulation.

Discussion

Sternal reentry remains a challenging problem confronting the
surgeon who corrects congenital heart conditions. The vast major-
ity of resternotomies are performed without incident. Nevertheless,
a small subgroup of patients have problems with sternal reentry,
such as those with a substernal homograft or shunt, a markedly
dilated right atrium, or aneurysms of the right ventricular outflow
tract.1-3 In larger patients femoral cannulation provides ready
access for cardiopulmonary bypass, but in younger patients the
femoral vessels are too small to cannulate. The iliac vessels are
suitably sized but require a retroperitoneal approach. Cervical
cannulation was championed by pioneers of extracorporeal mem-
brane oxygenation because of the ready accessibility and satisfac-
tory size for cannulation of this vessel. Concerns about cerebral
injury as a result of common carotid ligation in patients undergo-
ing extracorporeal membrane oxygenation are probably not appli-
cable in this case, because the common carotid artery is not ligated,
as is frequently done in extracorporeal membrane oxygenation,
but rather is cannulated through a purse-string suture, which should
allow antegrade flow around the cannula. If the potential need for
cervical cannulation is identified before the operation, patency of
the right and left internal jugular veins should be confirmed by
Doppler study before surgery. Cannulation of the right internal
jugular vein in the presence of an occlusion of the left internal
jugular vein could lead to cerebral venous hypertension and im-

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paired cerebral perfusion. Complete cannulation of the cervical vessels can be performed in approximately 10 to 15 minutes. Potential complications, such as late vessel occlusion, were not seen in this small series of patients.

Alternative cannulation sites should rarely be needed during resternotomy. However, cervical cannulation provides several advantages relative to femoral cannulation in smaller patients. Risk associated with this cannulation technique appears to be low.

Table 1. Clinical summaries

<table>
<thead>
<tr>
<th>Case</th>
<th>Diagnosis</th>
<th>Operation</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Truncus arteriosus; right ventricle to pulmonary artery conduit pseudoaneurysm</td>
<td>Repair pseudoaneurysm; replace right ventricle to pulmonary artery conduit</td>
<td>Prophylactic</td>
</tr>
<tr>
<td>2</td>
<td>Hypoplastic left heart syndrome, status post Norwood procedure</td>
<td>Hemi-Fontan</td>
<td>Bleeding—arterial bridging to sternal groove</td>
</tr>
<tr>
<td>3</td>
<td>Pulmonary atresia with intact ventricular septum; discontinuous pulmonary arteries</td>
<td>Pulmonary artery angioplasty</td>
<td>Bleeding—previously placed anterior shunt</td>
</tr>
<tr>
<td>4</td>
<td>Pulmonary atresia with ventricular septal defect; right ventricle to pulmonary artery conduit pseudoaneurysm</td>
<td>Repair pseudoaneurysm; replace right ventricle to pulmonary artery homograft</td>
<td>Prophylactic</td>
</tr>
<tr>
<td>5</td>
<td>Truncus arteriosus; right ventricle to pulmonary artery conduit obstruction</td>
<td>Replace right ventricle to pulmonary artery homograft</td>
<td>Bleeding—homograft adherent to sternal groove</td>
</tr>
<tr>
<td>6</td>
<td>Transposition of the great arteries, status post arterial switch; pulmonary artery aneurysm</td>
<td>Repair pulmonary artery aneurysm; bilateral pulmonary artery angioplasty</td>
<td>Prophylactic</td>
</tr>
</tbody>
</table>

References


Figure 1. A, Position of patient and site of incision for cervical cannulation. B, Completed dissection before cannulation. C, Cannulation of internal jugular vein. Vascular clamp is omitted for better visualization.