Cardiac Embolization of Ventriculo-Venous Shunts for Hydrocephalus*
Report of a Case

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In recent years, hydrocephalus is frequently treated by ventriculo-venous prosthetic shunt. It is important for thoracic surgeons to be cognizant of the problems associated with these procedures, since three cases have been reported in the literature of embolization of catheters introduced into the superior vena cava. Our case is another of this type. Undoubtedly, as more of these shunts are performed, the incidence of embolic complications will increase. Thoracic surgeons who have not had previous experience with this type of problem may encounter it in the future.

The catheters are not completely inert and are prone to cause thrombosis and damage to the vascular wall with resulting secondary infection. As emphasized previously in the literature, embolic intravascular or intracardiac foreign bodies should always be removed, for secondary complications frequently are lethal. Since the advent of extracorporeal circulation and hypothermia for safe entrance into the chambers of the heart, it is no longer hazardous to remove emboli. A case illustrating the x-ray findings and the techniques for removing this type of intracardiac foreign body is presented.

CASE REPORT:

T. R., a 20-month-old white boy was admitted to Wilford Hall United States Air Force Hospital on December 2, 1964 for the third time with the past history of a ventriculo-atrial shunt (Holter valve) performed for hydrocephalus in September, 1963. He did well until one week prior to admission, when redness was noted over the Holter valve in the neck. The area of redness, which increased in size during that week, seemed to be painful and the child was very irritable. Rectal temperature was 100°F. Lumbar puncture at the child’s local hospital revealed a spinal fluid pressure of 300 mm of water with 10 cells in the cerebrospinal fluid. Chest x-ray film revealed a foreign body in the right heart. After transfer to Wilford Hall United States Air Force Hospital, the physical examination revealed that the size of the head was 51 cm. The child was irritable and crying, and had an obviously painful 2 x 4 cm area of redness and induration in the right neck area immediately above the sternoclavomastoid and below the right ear. The anterior fontanelle was flat, somewhat tight, and 2 x 2 cm in size. The physical examination again confirmed the achondroplasia. The neurologic examination was normal.

Routine laboratory findings were within normal limits. Blood and wound cultures were sterile. The chest x-ray film (Fig. 1) disclosed a coiled catheter within the cardiac chambers. Apparently, a portion of it was in the right atrium and the rest extended into the right ventricle. The electrocardiogram showed evidence of occasional premature ventricular contractions and obvious irritability, manifested by varying voltage in the right atrial and right ventricular complexes.

Shortly after admission, under normothermia and halothane anesthesia, a right anterior thoracotomy was performed and the pericardium was opened. The superior and inferior venae cavae and the pulmonary artery were dissected and tapes placed around them. A disposable bag oxygenator for cardiopulmonary bypass was placed on standby. The catheter could be palpated in the right atrium and, by grasping the tip, it was pulled into the right atrial appendage. A vascular clamp was placed across the appendage, and right atriotomy performed. The catheter was grasped and removed by quickly opening and closing the vascular clamp. Use of this closed method made neither vena caval occlusion nor cardiopulmonary bypass necessary. In view of the possibility of infection and meningitis, the neck and cranial portions of the Holter valve were removed following thoracotomy. The distal

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portion of the polyethylene catheter had broken approximately 1.5 cm distal to its attachment to the Holter valve in the neck. The child did well postoperatively and was discharged from the hospital after two weeks. He was to return at a future date for evaluation and possible replacing of the atrioventriculo-atrial shunt.

COMMENT

Although complications have been associated with ventriculo-venous shunts, this procedure has offered patients with obstructive hydrocephalus an improved diagnosis. Thoracic surgeons should be aware of the possibility of foreign body embolization from this type of shunt. This case adds another to the three reported in the literature. The authors believe that the possibility of thrombus formation and septicemia from intracardiac foreign bodies dictates their removal. It is recommended that these foreign bodies be approached through a right anterior thoracotomy and that preparation be made to transect the sternum and enter the left chest if necessary.

It is probable that the majority of the foreign bodies can be removed by closed procedures from the right atrium; therefore, transection of the sternum would seldom be necessary. Another precaution would be to have a disposable bag oxygenator in the event that cardiopulmonary bypass is needed to remove a foreign body from the right ventricle or from a peripheral pulmonary artery.

REFERENCES

CARDIAC EMBOLIZATION OF VENTRICULO-VENOUS SHUNTS

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DIBENZYLNE EFFECT ON VASCULAR THROMBOSIS

Reimplantation of the lung was performed in three groups of animals. The incidence of pulmonary venous thrombosis was reduced from 55 per cent in the group which did not receive heparin or phenoxybenzamine (Dibenzyline) to 14 per cent in the group which received heparin. No thrombosis was found in the group treated with Dibenzyline and heparin. The over-all survival rate was improved in the latter group.

Pulmonary function studies of the reimplanted lobes showed a normal oxygen uptake, expired carbon dioxide and diffusion capacity by postoperative day 206. The early reduction in carbon dioxide release appeared to correlate the histologic findings of perivascular infiltration and thickening of the alveolar membrane. These findings were not present in sections obtained later in the postoperative period. The total pulmonary vascular resistance was only moderately elevated in both groups, both immediately after operation and later.

Homotransplantation was carried out in two groups of animals. The incidence of pulmonary venous thrombosis in the group which received heparin was 70 per cent, while only one animal, or 5 per cent of the Dibenzyline-treated group, had this complication.

It appears that the increase in lobar vascular resistance which is commonly observed after either reimplantation or homotransplantation is not affected by the administration of Dibenzyline.

DIBENZYLNE EFFECT ON VASCULAR THROMBOSIS

The mechanism of suppression of spontaneous respiration during EPR is mainly due to inhibition mediated through the vagus nerve. A preliminary report of clinical application of EPR to a patient with central hypoventilation is described.


ELECTROPHRENIC RESPIRATION

A technique for artificial ventilation by electrical stimulation (electrophrenic respiration-EPR) by means of radiofrequency induction is reviewed. Experimental long-term EPR results in diminished tidal volume. This change is reversible. EPR is easily induced under anesthesia with stimuli applied to the right phrenic nerve through an indwelling intravenous electrode in the superior vena cava.

MITRAL VALVE REPLACEMENT

Resistance to forward flow over a disc or ball valve is dependent upon the size of the residual valve orifice (inflow area) and the size of the frustum (outflow area). An insertion ring of any artificial valve restricts the valve orifice. Those valves with the thickest insertion rings will have the least residual valve orifice for flow; the smaller the valve employed, the greater this restriction and gradient.

The optimal design for a disc valve demands as narrow an insertion ring as possible to provide a large orifice area in addition to as large a frustum area as possible to reduce the resistance of the disc to forward flow and to allow a large free area for flow to escape between the disc and valve ring.

Laboratory studies indicated that a ratio of approximately 1 to 1.5 for orifice area to frustum area was necessary to provide the least gradient. The proximity of the frustum area anatomically to the posterolateral myocardial wall further restricts the flow of blood in this area. To overcome this, the frustum area for the disc valves of various sizes provided for his additional factor. The clinical results in the use of the disc valve of our design have demonstrated that it is associated with a lowered operative mortality and morbidity. The smaller cage has not interfered with myocardial contraction nor produced ventricular septal irritation. There has been a considerably lessened incidence of thromboembolism.


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