CORONARY SINUS INJURIES AN UNDERESTIMATED COMPLICATION OF CORONARY SINUS CARDIOPLEGIA

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Over a period of three years, a total of 942 coronary bypass procedures were performed at Prince Sultan Cardiac Center, In 620 patients, the retrograde coronary sinus cardioplegia catheter was used for the administration of the retrograde cardioplegic solution. We report four different types of coronary sinus injuries encountered (0.64%), and review the literature for other reported cases and the different types of management.

DELIVERY OF CARDIOPLEGIA through the coronary sinus has been gaining increasing popularity as a method of myocardial protection. In the United States, Buckberg reported that more than 90% of cardiac surgeons are currently using the retrograde technique alone or complementary to the antegrade technique for myocardial protection. The advantages of retrograde cardioplegia have been well documented, but there are few reports on the complications caused by this technique. Although the incidence of such complications is not exactly known, the evidence is accumulating, suggesting that the rate of coronary sinus rupture may be increasing. Coronary sinus rupture could also be of increasing incidence during the learning phase of the blind insertion technique of the retrograde cardioplegic cannula. When it occurs, it requires skillful repair and focussed attention.

Patients and Methods

Patients aged 45, 56, 59, 67 years, respectively, comprising 1 male and 3 females underwent elective coronary artery bypass surgery. A standard median sternotomy and pericardiotomy was done. The aorta was first cannulated, then a two-stage venous cannula was inserted through a right atrial pursestring suture. Another purse-string suture was placed on the right atrial free wall, two centimeters away from the right atrio-ventricular groove (course of right coronary artery) for insertion of the retrograde cannula before the institution of cardiopulmonary bypass. The blind insertion technique was used in all cases, whereby the heart is slightly retracted to the left side and cephalad, the right atrium is punctured and the retrograde cannula (DLP with self inflatable balloon) is directed to the coronary sinus (CS).

Direct palpation and or inspection of the cannula in the CS as well as monitoring the CS pressure trace were always used to confirm the site of the cannula in the CS. In all four cases, the retrograde route was used complementary to the antegrade cardioplegic route.

Diagnosis

In the four cases, there was a difficulty in introducing the cannula to the CS, and probably a forceful insertion was employed. In two cases a feeling that the CS gave way was felt during insertion of the cannula, when a massive venous bleeding was noticed coming from behind the heart, and the terminal part of the cannula was seen protruding from the coronary sinus.

In the other two cases two hematomas of variable...
sizes (2 x 3 cm² and 4 x 5 cm²) were observed at the back of the heart, around the coronary sinus. There was no bleeding in the last two cases, and the cannula was still in the CS.

Management

The retrograde CS cannula was withdrawn from the CS in all four cases, and the retrograde route was abandoned. With immediate institution of cardiopulmonary bypass, systemic hypothermia to 25°C, the aorta was cross-clamped, and the initial dose of ante grade blood cardioplegia (one liter) was given to arrest the heart. The heart was vented from the aortic root, gently retracted the cephalad, and the CS area was examined carefully. In the two cases, the two hematomas were intact around the CS (subepicardial hematomas), and it was decided that both be left undisturbed. In the other two, there was a complete tear of the CS. The first tear measured 1.5 cm and was repaired successfully with continuous 7/0 polypropylene suture after a little trimming of the coronary sinus edge. The second one was larger (2.5 cm x 0.5 cm), so it was decided to use a fresh autologous pericardium to repair it. A continuous 7/0 polypropylene suture was used to sew the rhomboid pericardial patch to the CS edge on side the side nearest the pericardium. The other edge of the pericardial patch was sewn to the epicardium close to the CS, so that the stitches were superficial, and parallel to the obtuse marginal arteries. The repair was successful in the two cases and the operation continued in the usual fashion. Before decaJ;]]uating the aorta after reversal of anticoagulation, a second look at the CS confirmed proper hemostasis. The four patients had an uneventful postoperative course and echo Doppler study on the fifth postoperative day. was satisfactory. One month follow-up with echo did not reveal any problems.

Discussion

Coronary sinus injury is a rare but a potentially lethal complication of the retrograde cardioplegia technique. A small sinus in a frail patient may be stretched to the point of rupture during inflation of the balloon.2 The presence of a membrane closing the orifice of the coronary sinus can also lead to difficult introduction6 and entl up with CS injury.

In our cases, the retrograde cannula with a self-inflatable balloon was used, and forced insertion due to small sinus or abnormal valve might have resulted in the complications seen. Complications still happen when using the manually inflatable balloon, in spite of the fact that most surgeons follow the recommendations of the manufacturer. Some surgeon have recommended a careful way of inflating the balloon, which is accomplished by leaving the balloon completely deflated until the initiation of cardioplegia delivery. 8 As the cardioplegia is delivered slowly and cautiously, the balloon inflation is proceeded while carefully watching the CS pressure readout on the monitor. As soon as the pressure began to increase, indicating adequate obstruction to the backflow into the atrium, the balloon inflating is stopped.

Brady et al. 9 reported three cases of delayed coronary sinus rupture that required urgent sternotomy for control of cardiac tamponade, as nonsurgical causes of coronary sinus rupture. The three cases followed catheter-mediated electrical ablation of posterior accessory atrioventricular pathways.. Coronary sinus rupture correlated with the ratio of catheter diameter to CS diameter in these three cases.

Menasche et al.12 described three different types of coronary sinus injuries: 1) hematoa of the atrioventricular groove, usually due to overpressurization (in our cases, it was caused by repeated and difficult trials of insertion), which in absence of overt rupture, should be resected; 2) punctuate perforation of the CS wall secondary to a traumatic style-guided catheter insertion which can be repaired easily by a few 6/0 polypropylene stitches; 3) extensive laceration of the coronary sinus, which is the most difficult and requires repair. In one of our cases which was repaired successfully using continuous 7/0 polypropylene stitch, the tear was close to the type-2 described by Menasche, and was even longer and wider. In another case, there was a large laceration which really needed a direct repair, and using autologous pericardial patch turned out to be an effective method of achieving repair and thorough hemostasis at the same time.

Certain important technical principles in repairing large CS lacerations have been emphasized by Fleisher et al. 2.3.S The first principle is adequate exposure of the damaged area to permit accurate placement of the sutures, which implies a total decompression of the left ventricle (venting through right superior pulmonary vein is recommended). Venting through an already placed aortic root vent in
our case was sufficient, however the right superior pulmonary vein would have been more effective. The second principle is that any type of material can be used for repairing the ruptured CS, autologous pericardium, autologous vein patch, or bovine pericardium. Autologous pericardium is especially attractive because of its numerous advantages such as immediate availability, escape of postoperative pain, handling, fashioning, and suturing, hemostatic effectiveness due to its thickness and lack of porosity; and absence of additional cost. Some surgeons believe that repairing the CS with a patch can lead to narrowing of the sinus and invite more bleeding and later thrombosis of the CS. We agree with Menasche and Fleisher that repairing the CS using pericardial patch may be the best way to control bleeding and prevent narrowing of the sinus. Weiss' used an 8 mm thin-walled Gore-Tex conduit between the right atrium and a pericardial patch used for the repair of CS to allow an alternative route for coronary sinus return to the right atrium. The third point which should be emphasized, is that the patch should be sewn far away from the site of injury by means of fine monofilament suture (e.g., 6/0 or 7/0 polypropylene) used in a running fashion. On the ventricular side of the sulcus, sutures should be placed superficially across the epicardium, care being taken not to injure the major branches of the left circumflex coronary artery. Topical application of biological glue along the suture line can be useful. Finally, the attention paid to the repair, which can be time consuming should not distract from being equally committed to the quality of myocardial preservation during this phase and from performing the operation itself.

The best treatment for such rare and potentially lethal injuries is prevention. A careful insertion and cautious inflation of the balloon as described before is necessary. However the use of a retrograde cannula with a self-inflatable balloon may be safer. It could also be easier as preferred by some surgeons, to cannulate the CS before the patient goes on bypass and before the insertion of the right atrial cannula. There is no obstruction the right atrium is distended, and the CS is full. In our institution, as well as many others, cannulating the CS after right atrial cannulation is easy and carries no major risks. It has the advantage of avoiding misinsertion to the inferior vena cava which is already occupied by the right atrial cannula. Direct observation of the retrograde cannula under direct vision, palpating the cannula in the CS, and monitoring the pressure trace from the CS are all important tools to confirm proper positioning of the cannula. If any difficulty is experienced during cannulation of the coronary sinus, and repeated careful trials are attempted, avoiding the retrograde technique may be the right decision.

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