VENOUS INFLOW OCCLUSION: PRINCIPLES, PITFALLS, CASES
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Key Points
- Cardiac surgery during venous occlusion should be carefully scripted
- Duration of circulatory arrest should be < 2 minutes if possible
- Keep temperature > 32° C to avoid ventricular fibrillation
- De-air the heart just prior to closure of the cardiotomy

Inflow occlusion is a strategy for performing brief open cardiac repairs. It involves interruption of venous blood returning to the heart and a brief period of complete circulatory arrest. It is indicated for cardiac surgeries that require only a brief period for open heart repair. Its principal advantages are its simplicity, lack of need for specialized equipment, and associated minimal cardiopulmonary, metabolic, and hematological derangement after surgery. The principal disadvantages of inflow occlusion are the limited time it provides to perform cardiac surgery, motion of the surgical field, and the unavailability of a rescue strategy should delays occur in the completion of surgery. As a result, cardiac surgery performed during inflow occlusion must be meticulously planned and executed.

Ideally, the duration of circulatory arrest in a normothermic patient should be 2 minutes or less to minimize the risk of cerebral injury and ventricular fibrillation. If necessary, inflow occlusion can be repeated to allow completion of a cardiac surgery. If repeated, adequate time for complete recovery of the myocardium should be allowed between inflow occlusions. Circulatory arrest time can be prolonged up to 4 minutes with mild whole body hypothermia (32° to 34° C). The temperature should not be allowed to fall below 32° C because the risk of ventricular fibrillation increases significantly below this temperature.

Inflow occlusion can be accomplished from a left or right thoracotomy, or a median sternotomy, depending on the cardiac procedure being performed. Tourniquets are placed on the vena cavae and azygous vein to accomplish inflow occlusion. During occlusion, care should be taken to exclude the right phrenic nerve during placement of tourniquets on the vena cavae to avoid injury to the nerve. Direct access to the vena cavae and azygous vein for inflow occlusion is readily achieved from a right thoracotomy or median sternotomy. Access for inflow occlusion is more difficult from a left thoracotomy, particularly when the heart is enlarged.

Drugs and equipment for full cardiac resuscitation should be available. Ventilation should be discontinued during inflow occlusion to prevent pulmonary blood from being pushed into the surgical field during inspiration. De-airing the heart is a critical step at termination of venous inflow occlusion to avoid a fatal air embolus. This is accomplished by simultaneous release of one tourniquet and a large positive pressure breath (i.e. Valsalva) just prior to closure of the cardiac incision. Gentle cardiac massage may be necessary after inflow occlusion to help reestablish cardiac function. Digital occlusion of the descending aorta during this period helps direct the available cardiac output to the heart and brain. If ventricular fibrillation occurs, the heart should be defibrillated by direct electrical shock immediately after inflow occlusion is discontinued.
Cardiac incisions are initially closed with vascular clamps to minimize the length of circulatory arrest times. After cessation of inflow occlusion and cardiac function is restored, the cardiac incisions are closed with suture.