Departmental Clinical Protocol Manual

Clinical Protocol
CP.XX.xxx

*The intent of this product is to be a resource; not a replacement for institutional protocols. Standard 1 of AmSECT's Standards and Guidelines for Perfusion Practice.[1] These Standards and Guidelines may also be superseded by the judgement of the healthcare professional considering the facts and circumstances of the individual case.

SUBJECT/TITLE: Vacuum-Assisted Venous Drainage (VAVD)

PURPOSE:

VAVD is a technique used to augment and optimize venous return flow rates during cardiopulmonary bypass (CPB). If indicated for specific patient populations, the application of VAVD allows for the minimization of circuit components, such as a reduction in size of the venous cannulae and/or the length and diameter of the venous line itself. VAVD can be used to improve venous return through peripheral venous cannulation. It also provides for venous drainage with an unprimed venous line if desired. VAVD is not dependent on gravity for venous return. VAVD can be used in both adult and pediatric surgery when siphon gravity venous drainage is suboptimal.

TARGET POPULATION:

VAVD may be indicated for any patient population requiring a reduction in the circuit prime volume secondary to limiting the effects of hemodilution, surface area contact of the blood, and/or donor blood transfusion. VAVD is also useful in populations undergoing peripheral venous cannulation for the initiation and maintenance of CPB.

DEFINITIONS:

Vacuum-Assisted Venous Drainage (VAVD) uses a wall vacuum or other source of suction to create a negative pressure via a regulator within a sealed hard-shell venous reservoir (HSVR), or within a sealed housing surrounding a soft-shell reservoir.

POLICY:

Implementation of VAVD requires a slight sub-atmospheric pressure applied to the venous cannula and venous line by a regulated vacuum source. VAVD can be used for minimally invasive cardiac surgery, cases requiring femoral venous cannulation, as well as normal cardiopulmonary bypass cases.

Initiation of bypass is performed in a classical way with a cardiotomy reservoir open; vacuum is added as soon as the maximal gravity drainage is reached. During bypass, when the blood level in the reservoir decreases to the safety limit level, a small increase in negative pressure is used to improve venous drainage. For weaning from bypass, the negative pressure is gradually decreased to zero, then the reservoir is opened, and the venous line progressively closed. VAVD should never be applied in the absence of forward flow through the CPB oxygenator, in order to prevent air from being pulled across the membrane into the blood path.

PERFUSION PUMP CONSIDERATIONS:

Modifications to cardiopulmonary bypass may include reducing the length and/or diameter of the venous line and the initiation of CPB with an unprimed venous line, if desired. A vacuum regulator, disposable VAVD setup, pressure transducer, and pressure relief valve are recommended for the conduct of VAVD.

PROCEDURE:

1. Prepare the cardiopulmonary bypass circuit according to your institution's protocol.
2. A sealed, hard-shell venous reservoir (HSVR) is used. Dead-end tubing stubs and non-vented luer caps are placed where needed to ensure the maintenance of a stable vacuum within the reservoir.
3. Connect a sterile pressure transducer to the luer port on the venous inlet of the venous reservoir. Prime and zero the transducer. If applicable, set alarm to alert for developing positive pressure (0-5 mm Hg). Ensure the presence of a pressure relief valve on the HSVR for safe VAVD operation.
4. Leave an empty prime bag attached to an "open" rapid prime line attached to the HSVR. In the event of reservoir pressurization this bag will inflate, providing a visual cue that the reservoir is pressurizing.
5. Connect a sterile vapor trap to the vent port of the venous reservoir. Do not allow the vapor trap to be filled with fluid. This will impede normal venting.
6. Check the vacuum regulator for proper function and set it for minimal negative pressure (-10 to –30 mm Hg).
7. Connect suction tubing with a "Y". Attach the single end to the vacuum regulator. Attach the end with the "Y" to the vapor trap, leaving one leg of the "Y" open and within easy reach. This is your vent line.
8. To initiate CPB, institute arterial pump flow, then unclamp the venous return line and clamp the vent line. This will allow for the vacuum to draw venous blood into the venous line. Do not apply vacuum to the venous reservoir when there is no forward blood flow through the oxygenator. This applies to both centrifugal and roller pumps. This will prevent air from being pulled across the membrane into the blood path by the reservoir vacuum.
9. Monitor pressure on the venous line using a venous pressure transducer setup. Do not exceed vacuum levels greater than –60 mm Hg. Vacuum system failure or mismanagement could lead to a pressurization of the sealed HSVR due to input from the pump suckers. Air embolism can occur with air moving retrograde via the venous line or antegrade across the blood path of the oxygenator.
10. To terminate CPB, unclamp the VAVD vent line. This opens the system to atmosphere relieving the negative pressure and venous return is converted to siphon drainage. CPB is terminated as usual per standard weaning parameters.

    Regardless of the arterial pump type, arterial flow should never be terminated with an active vacuum applied to the HSVR.

CLINICAL ASSESSMENT/SCREENING:

A. Contraindications: patients with an open communication to the left chambers of the heart. In the event of over-pressurization of the venous circuit accompanied by retrograde flow, the potential for a massive air embolus through an atrial septal defect or patent foramen ovale serves as a major incident associated with VAVD mismanagement.
B. Clinical refinements for the safe clinical application of VAVD include:
    a. Avoiding macroemboli in the venous line during initiation of bypass;

b. Ensuring purse-string sutures on the venous cannula are tight;
c. Careful deairing of the syringe before drug administration as well as discarding stagnant blood before sampling;
d. Withdrawing of blood and injection of drugs on the manifold in a gentle manner;
e. Monitoring of venous reservoir pressure to avoid excessive negative pressure that may cause venous microemboli and cavitation of the venous structures of the heart;
f. Operator awareness during sucker bypass in the prevention of potential over-pressurization of the VAVD system resulting in a retrograde air embolus;
g. Using membrane oxygenators with a built-in or added pressure relief valve;
h. Opting for a membrane oxygenator and a venous reservoir with the ability to remove gaseous microemboli; and
i. Using a new membrane oxygenator with a built-in arterial filter or added arterial filter.

RELATED DOCUMENTS:

For further reference please see the Medtronic Guide to Augmented Venous Return Techniques.

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APPROVED BY: *(signature of CMO and CNE only required)*

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