

The Role of Nasopharyngeal Temperature Monitoring in Detection of a Malpositioned Superior Vena Cava Cannula in an Emergency Coronary Artery Bypass in a Patient With Ventricular Septal Defect

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A 55 year-old woman was admitted to the CCU ward of our university hospital due to typical chest pain. The patient received supportive care and was transferred to the operating room for an emergency repair of the ventricular septal defect (VSD) and myocardial revascularization. The surgical team was notified regarding the tolerance to cooling detected by the temperature monitoring and also, the congestion of eye and blanching of forehead. After a few maneuvers, the cannula was repositioned. In a few seconds, the forehead was cooled, while the airlocking episodes were lifted completely and the blanching and chemosis in the face and eyes all resolved. The septal defect was approached through the left ventricle; a 15 in 20 mm foramen, due to the ischemic rupture of the superior portion of the anteroseptal wall, was repaired with a patch of hemoshield. The incision over the LV was then repaired with 2 parallel bands of felt. The patient was operated on and transferred to the intensive care unit.

Case presentation

A 55 year-old woman was admitted to the CCU ward of our university hospital due to typical chest pain not responding to usual anti-angina drugs. She had a 20 years history of diabetes mellitus. The cardiac assessments including electrocardiography and cardiac biomarkers suggested an acute myocardial infarction. Bedside echocardiography showed a moderately depressed left ventricular function (EF= 35%) plus a trans-ventricular jet from the left to the right ventricle. The coronary angiography results demonstrated totally cut left anterior descending (LAD), near cut right coronary artery (RCA) and diffuse stenosis of the posterior descending artery (PDA) with a left dominant pattern of the coronary arteries. A post-myocardial infarction ventricular septal defect (VSD) with a left to right shunt was also detected. The patient received supportive care for hemodynamic stabilization; including insertion of an intra-aortic balloon counter-

pulsation; due to the cardiogenic shock at the time of the coronary angiography. Afterwards, she was transferred to the operating room for an emergency repair of the VSD and myocardial revascularization.

Surgical operation started after induction of anesthesia under strict hemodynamic control. Full heparinization was administered and the patient's aorta was cannulated. Two venous cannulae were inserted in both venae cavae. Full cardiopulmonary bypass started after ensuring the effect of heparinization through an activated clotting time measurement (ACT).

While the temperature was tried to be reduced, its monitoring did not show substantial reduction and proper cooling of the forehead was not detected by touching its surface. Also, the patient had chemosis and blanched forehead. Venous return to the cardiopulmonary bypass circuit and reservoir was also diminished. Meanwhile, multiple episodes of airlock in the main venous line to the CPB were noticed and the SVC venous cannula was checked by the surgeon. After a few maneuvers, the cannula was repositioned and in a few seconds, the forehead was cooled, while the airlocking episodes ceased completely and the blanching and chemo-

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sis in the face and eyes all resolved. After stabilizing the circulation in the CPB, the right atrium to the superior vena cava (SVC) junction was found to be partially ruptured which was sutured and repaired.

After asystole, coronary artery revascularization was performed. The septal defect was then approached through the left ventricle: a 15 in 20 mm foramen had been formed, due to the ischemic rupture of the superior portion of the anteroseptal wall, which was repaired with a patch of hemoshield. Subsequently the incision over the LV was repaired with 2 parallel bands of felt.

The patient was weaned from the bypass circuit using inotropic agents (including epinephrine and milrinone) accompanied with intra-aortic balloon counter-pulsation and was transferred to the intensive care unit.

Discussion

One of the main problems encountered during cardiopulmonary bypass is assurance of proper blood drainage from the patient venous system into the bypass reservoir. Since power of gravity is the main driving force for blood drainage from the patient's body into the reservoir, such drainage is mainly a passive process which demands an acceptable level of mandatory vigilance.¹⁻³

There are a number of signs and landmarks which ensure anesthesiologists, perfusionists and surgeons, that venous drainage is ongoing properly. Maybe the best known of these assurances is the trend of blood level in the reservoir which is somewhat acceptable if it remains stable despite a fixed rate of bypass flow.⁴⁻⁶

But there are a few situations in which a subtle amount of drainage failure may cause a drastic consequence. Among these one may consider failure of head and neck venous drainage in a bypass circuit which involves both the superior and inferior vena cava cannulae. Any malposition or occlusion in the superior vena cava cannula may cause very severe and unpredictable outcomes; since the perfusion pressure under bypass is usually lower than the normal physiologic state, somewhat due to the cooling process and the altered rheologic characteristics induced by temperature changes. So, any altered drainage of the venous system may cause an altered level of arterial perfusion because the increased venous pressure induced by cannula malposition or occlusion decreases the arterial-venous pressure gradient and this would finally result in

decreased perfusion pressure to head and neck.⁷⁻⁹

Anyway, proper temperature management is a key role in patients undergoing cardiopulmonary bypass and should arouse our extra vigilance since it is among the most important strategies to cause attenuation of myocardial and cerebral injuries during bypass.¹³⁻¹⁵

During the early stages of bypass, known as its starting phase, the perfusion of the organs is not only responsible for oxygen supply, but is also crucial for cooling process. This is a fundamental item for bypass and the main strategy for brain protection.¹⁰⁻¹²

This is why the team, especially the anesthesiologist's vigilance is crucial to monitor the surface temperature of the head and neck by frequent touching of the patient's forehead and shoulders. This may at times be even more sensitive than the conventional control of temperature by nasopharyngeal probes.^{13,14}

The temperature control during CPB, demands a very strict and rigid surveillance besides having to place a great emphasis on monitoring arterial temperature. Since arterial temperature is a major marker of potential cerebral hyperthermia, awareness is needed during CPB not to depend only on the nasopharyngeal temperature measurements.¹²⁻¹⁵ It has been previously mentioned that measurements of temperatures through the tympanic membrane and monitoring of the thigh temperatures by touching are the best way for control of rewarming after cardiopulmonary bypass.¹²⁻¹⁴

According to our experience in this case, a manual control of temperature could even precede the early recordings of nasopharyngeal temperature monitoring, and help detect impaired superior vena cava drainage which leads to impaired cerebral perfusion and cooling. Thus, tactile control by hand rather than by machines is still a more reliable means of temperature control.

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