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Diagnostics and treatment of hemodynamic disorders in cancer patients: current trends and own experience

Relevance: *Hemodynamic disorders occupy a central position among pathological syndromes in patients receiving intensive care. Still, their diagnostics and treatment are sometimes delayed, and hemodynamic parameters and types of blood circulation are misinterpreted. This adds to the severity of such disorders and increases mortality.*

The purpose of the study *was to analyze the diagnostics and treatment of hemodynamic disorders in cancer patients.*

Results: *The applied methods of clinical diagnostics and non-invasive monitoring of hemodynamic parameters correlated well with invasive monitoring methods and have proven useful in the everyday practice of intensive care.*

Conclusion: *A combination of methods of clinical diagnosis of hemodynamic disorders and with modern non-invasive methods of measuring central hemodynamics parameters allows for earlier and more accurate diagnostics and correction of hemodynamic disorders in the perioperative period in cancer patients.*

Keywords: *hemodynamics, hemodynamic disorders, cardiac output, central venous pressure.*

Introduction: Circulatory disorders are the centerpiece of pathological syndromes registered in ICU patients. Despite that, in practice, we still observe untimely diagnostics and correction of these disorders, as well as incorrect interpretation of hemodynamic parameters and blood circulation types. All these add to the severity of such disorders and increases mortality [1]. Circulatory disorders are also observed during anesthetic management of surgery.

This is especially common in the oncological practice due to such reasons as large-scale surgical interventions, blood loss, elder age of patients, cardiovascular comorbidities, as well as reduced reserve capabilities of the human body.

Clinically, circulatory disorders are manifested by changes in blood pressure (BP), heart rate (HR), pulse rate and central venous pressure (CVP), skin condition, and decrease in urine output rate. In-depth hemodynamic monitoring of such indicators as cardiac output (CO), cardiac index (CI), systolic output (SO), and total peripheral vascular resistance (TPR), is not always available. Therefore, the diagnosis begins with a comparison and analysis of the available data.

The three classical types of blood circulation include:

- Hyper circulation (high CO at low TPR) which is typically observed in sepsis;
- Hypo circulation (low CO at high TPR) which is most common in so-called "cold" (hemorrhagic, hypovolemic) shocks;
- Normal circulation (standard CO and TPR).

That is, one shall somehow assess the vascular tone and cardiac efficiency to determine the type of blood circulation.

In this view, the use of advanced (invasive) hemodynamic monitoring may seem justified. However, this method has some disadvantages, such as high cost, specific operator skills, invasiveness, and related risks (procedure-associated complications, infections) [2]. All these make non-invasive monitoring increasingly popular in anesthesiology and intensive care.

The purpose of this study was the analysis of diagnostics and treatment of circulatory disorders in cancer patients.

Materials and methods: The clinical diagnostic methods developed by the Department of Anesthesiology and Resuscitation with a course of transfusion medicine of the Kazakh Medical University of Continuing Education [3] are routinely applied in the Resuscitation, Anesthesiology and Intensive Care Department of the Kazakh Institute of Oncology and Radiology (KazIOR) to diagnose circulatory disorders. Modern non-invasive equipment is additionally used to measure CO.

The skin condition – cold or hot – is a sign of a changed vascular tone. Along with BP level, the skin condition enables the clinical determination of the blood circulation type: low BP or a lack of adequate increase in BP in response to stress with warm skin is indicative of hyper circulation – a circulatory insufficiency. Such a hemodynamic status requires prescribing vasoconstrictors. A low BP or a lack of adequate increase in BP in response to stress, with cold skin or microcirculation disorders, is indicative of hypo circulation, which is associated with an increased afterload and could be the indication for prescribing vasodilators.

Some pharmacological tests are used to clarify the changes in TPR. **Vasodilator test** is performed at suspected TPR elevation using magnesium sulfate or nitrate drugs: 5 ml magnesium sulfate 25% is administered slowly, or ISO-MIK 0.25-0.5 mg as a bolus dose. A positive test result with HR reduction and BP elevation indicates a high TPR and confirms the initially elevated TPR. Such patients are prescribed peripheral vasodilators.

Vasoconstrictor test is also performed in case of tachycardia in combination with low BP, but with warm skin, i.e., at suspected reduced TPR. 25-75 µg of Mesaton is administered under BP and HR monitoring. The test is positive at a significant HR reduction and BP elevation. This will indicate a low TPR and the need for vasoconstrictors. In this case, tachycardia will have a compensatory role – to support cardiac output during a sharp TPR decline.

Particular attention is paid to the CVP value since it indicates the pulmonary heart preload and should not be unambiguously associated with the total blood volume (TBV). According to modern concepts in hemodynamics, the normal CVP value in ICU patients is close to zero. In contrast, high CVP values (which are normal for healthy people) are associated with impaired microcirculation and congestion in the splanchnic region [3], acute renal damage [4], and increased mortality [5].

A low or negative CVP may indicate a decrease in venous system capacity and is a safety criterion for volumetric infusion therapy. However, a low or negative CVP is an indication for volumetric infusion therapy only in the absence of tachycardia or edema, and with signs of dehydration. Provided that, a clinician should remember that in the states with increased cardiac output (including sinus tachycardia), CVP tends to zero. Elevated CVP in the absence of tachycardia or normal (relatively elevated) CVP in tachycardia is indicative of cardiac insufficiency or lung hyperhydration. Also, in the modern view, CVP is not a predictor for infusion therapy [6], but it could suggest when infusion therapy should be stopped.

In addition to clinical methods for assessing circulatory disorders, we actively use non-invasive CO measurement method based on the pulse wave transit time (PWTT) analysis (esCCO method, "Nihon Kohden" monitor, Japan) as an alternative to invasive methods in especially severe patients. This method allows calibration by arterial pressure measured by invasive or non-invasive methods. According to the literature [7] and our experience, this method provides a fair correlation in comparison with more invasive CO measurement methods. It is important that the esCCO method can be used for continuous monitoring or to control the effectiveness of the treatment for circulatory disorders. We use the esCCO method to measure CO during the most extensive and complex interventions in surgery for gastric, esophagus, and lung cancer, extended interventions in abdominal and gynecological oncology, in patients with a severe concomitant pathology, and the case of a complicated postoperative course.

In total, we analyzed 52 patients (32 (61.54%) men and 20 (38.46%) women) in the postoperative period after extensive surgical interventions due to cancer of various localizations who had circulatory disorders in the early postoperative period. The average age was 58±5 years. The nosological forms were diverse and were not critical in this study. In all patients, the initial form of circulatory disorder was diagnosed by using the above clinical methods. 41 (78.85%) patients had hyper circulation, and 11 (21.15%) had hypo circulation. Of them, 7 had vascular dysfunction as an initial disorder, and 4 had a cardiac deficiency with a compensatory vascular dysfunction. NihonKohden monitor was used for additional 24-hour instrumental diagnostics by the esCCO method. The initially determined type of circulatory disorder was confirmed in 37 (90.24%) patients with hyper circulation and 10 (90.91%) patients with hypo circulation. Cardiography and echo-cardiography were used as additional methods.

Results: The presented methods for the clinical diagnostics of circulatory disorders showed good credibility in identifying hemodynamic disorders in peri-operative cancer patients. Besides, the used non-invasive methods for monitoring central hemodynamics correlated well with the more invasive methods. The obtained data allowed a targeted and more efficient treatment of detected disorders.

Conclusion: The combination of methods for the clinical diagnostics of circulatory disorders with modern non-invasive methods for measuring central hemodynamics ensures an earlier and more precise diagnostics and treatment of circulatory disorders in perioperative cancer patients.

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