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PREVENTION MECHANISM OF BLEEDING CONDITIONS

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Bleeding is the process of blood flowing from damaged blood vessels, which is a direct complication of combat wounds and the primary cause of death among the wounded on the battlefield and during evacuation stages. During the Great Patriotic War, among the wounded who died on the battlefield, 50% succumbed to bleeding, while in military medical areas, it accounted for 30% of all fatalities. In Afghanistan, 46% of the wounded died from bleeding and shock in military medical facilities such as medical battalions and garrison hospitals [1,2,3,4,5].

Bleeding is classified based on the time of occurrence, the nature and caliber of the damaged blood vessels, and the site of blood loss. There are primary and secondary bleedings. Primary bleeding occurs immediately after an injury or within the first few hours due to factors like loosening of a pressure bandage, displacement of a blood clot from the injured vessel when moving the wounded, shifting of bone fragments, or increased arterial pressure. Secondary bleeding is divided into early and late types [6,7,8,9].

Early secondary bleeding occurs before the thrombus is fully organized, typically on the third to fifth day after injury, due to the detachment of a loosely formed clot blocking the wound. This may happen due to poor immobilization, jolts during transportation, or wound manipulation during dressing changes. Late secondary bleeding happens after thrombus organization and is associated with infection, clot

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dissolution, hematoma suppuration, or sequestration of the injured vessel wall. Secondary bleeding most often occurs in the second week after injury. Warning signs include pain in the wound, fever without signs of drainage obstruction, sudden brief soaking of the dressing with blood, and detection of vascular murmurs during auscultation of the wound area [10,11,12,13,14].

Secondary bleeding can sometimes stop on its own but poses a risk of recurrence. Regardless of the type, blood loss has common consequences. Recognizing the signs of blood loss is essential to differentiate them from other conditions such as trauma effects or disease processes. The specifics of different types of blood loss are discussed in specialized surgical sections. Blood loss is classified by volume and by the severity of resulting changes in the body. The severity of post-hemorrhagic disorders is assessed primarily by the depth of developing hypovolemia, which depends on the volume of lost circulating blood [15,16,17,18].

Blood loss is evaluated in terms of the reduction in intravascular fluid volume, loss of red blood cells that transport oxygen, and plasma loss, which is crucial for tissue metabolism. The primary pathogenic and lethal factor in blood loss is the reduction of blood volume, leading to hemodynamic disorders. Another critical factor is oxygen deprivation. Hemodynamic and anemic factors activate the body's protective mechanisms, which can compensate for blood loss. Compensation occurs through shifting extracellular fluid into the bloodstream, increased lymphatic drainage, regulation of vascular tone known as centralization of circulation, increased heart rate, and enhanced oxygen extraction in tissues [19,20,21,22].

The easier the compensation, the less blood is lost and the slower the bleeding occurs. However, when compensation fails or when decompensation occurs, blood loss progresses to hemorrhagic shock, which is defined by its primary cause. The so-called fatal threshold is determined not by the total blood loss but by the number of red blood cells remaining in circulation. The critical reserve is 30% of the red blood cell volume and 70% of plasma volume. The body can survive losing two-thirds of red blood cells but cannot endure losing one-third of plasma volume.

This understanding of blood loss allows for a more comprehensive assessment of the body's compensatory processes.

When determining the severity of blood loss, the wounded person's condition is assessed based on hemodynamic disturbances, clinical signs, and hematological indicators. In all cases of severe blood loss, diagnosis is conducted using the simplest and least time-consuming methods, as there is no time for additional examinations that could delay urgent surgical intervention. This applies to the evaluation of critically wounded patients arriving at a hospital with massive blood loss [23,24].

There are two levels of urgency in diagnostics, corresponding to decisions regarding surgical intervention, whether emergency, delayed, or early surgery. The primary goal of the assessment is to determine the severity of the wounded person's condition, the characteristics of the bleeding, and the extent of blood loss, leading to a clear decision on treatment strategy [1,2,3,4].

Thus, the scope of examination depends on the patient’s condition and medical priorities. The first to be examined are severely wounded patients with a clearly identified bleeding source, where treatment must begin immediately upon assessment, with no delay in surgical decision-making. In unclear cases, where it is necessary to identify the bleeding source and assess the severity of the body's response, examinations are repeated. Further diagnostic steps are clarifying in nature, often conducted under dynamic observation, but ultimately result in a treatment decision [17,18,19,20].

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