

ABSTRACT

The invention relates to clinical cardiology and cardiovascular surgery. The method for forming a blood flow in research stands and in surgically reconstructed segments of the blood circulation system comprises diagnosing the individual condition of a patient's blood circulation system; measuring the blood flow velocity field in the heart chambers and great vessels; comparing the parameters measured against the physiological norm; determining parameters forming a swirled blood flow; and modeling an individual swirled blood current in the blood circulation system being diagnosed, the streamlined surfaces and guide elements of flow channels of the blood circulation system reconstructed being given shapes conforming to the flow lines of the restored normally swirled blood flow in accordance with formulas:

$$Q(t) = [z + Z_0(t)]^2 \quad (1.1)$$

$$\varphi = \varphi_0 + k(t)z \quad (1.2)$$

$$k(t) = \Gamma_0(t)/4\pi Q(t)C_0(t) \quad (1.3)$$

$$V_z = 2C_0(t)z$$

$$V_r = -C_0(t)r$$

$$V_\varphi = \frac{\Gamma_0(t)}{2\pi r} \left\{ 1 - \exp \left[\frac{-C_0(t)r^2}{2\nu} \right] \right\}$$

wherein: V_r , V_z , and V_φ are the radial, longitudinal, and tangential velocities of the swirled current; ν is the kinematic viscosity of the medium; φ_0 is the initial swirling angle in relation to the flow axis normal; φ , z and r are current values of the angular, longitudinal, and radial coordinates along the flow line; and $Q(t)$, $Z_0(t)$, $k(t)$, $\Gamma_0(t)$, and $C_0(t)$ are parameters of the swirled blood flow variable over time because of the non-stationary current and corresponding to the individual normal indicators for a physiologically swirled blood flow. The normal indicators are established by routine examination of a representative sample of patients having no changes in the cardiovascular system. A vessel prosthesis comprises a tube having an internal surface in contact with the blood flow provided with a pattern to swirl the blood flow in accordance with formulas (1.1 to 1.3) conforming to a specific localization of the segment being reconstructed. A cannula for para-corporeal perfusion devices comprises a flow channel having an internal surface that is provided with a longitudinal pattern to swirl the blood flow, the shape of the pattern being determined from formulas (1.1 to 1.3), relative to the specific localization of the point where the cannula is inserted into the vessel channel. A heart valve prosthesis comprises one or more shutoff elements arranged symmetrically in the center of a body of round and/or oval cross-section, the streamlined surfaces of the valve being provided with a pattern in accordance with formulas (1.1 to 1.3). A blood pump comprises a flow swirling unit, a flow channel, and valves at the inlet and outlet of the channel, the surface washed over by blood being provided with a relief variable over time in accordance with formulas (1.1 to 1.3). A swirling device comprises an end piece having a streamlined

surface provided with guides in the form of ribs, grooves, or blades of a shape defined by formulas (1.1 to 1.3), the swirling angle of the guides relative to the flow axis being varied optionally an operator or by a special-purpose device for modeling different current conditions.