Doppler Sonography for Children with Osteosarcoma and Ewing's Sarcoma

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Purpose

Taking into account features of the pathogenesis of malignant neoplasm at the stage of primary diagnosis in addition to combination of methods of medical visualization require the presence of major pathophysiological clinical indicators characterizing of the livelihood of a native tumor and, above all, its blood supply. Systemic approaches in studying blood supply of bone sarcomas had not yet been demonstrated [1,2,3]. The task of the present study is to study some aspects of the pathogenesis disorders of macrohemodynamics at the systemic, organ, and intratumoral levels in malignant tumors of the lower extremities to improve of ultrasonic method in the diagnosis of osteosarcoma and Ewing sarcoma in children.
Methods and Materials

Ultrasound examinations were done of 21 children and adolescents of both sexes, 8-17 years, with OS (median of age 13 (12-15 years) and 14 - with ES (median of age 12 (10-16) years). All of the tumors were localized at the lower extremities. These were morphologically-confirmed sarcomas of the tubular bones (in the 2-4 stages of disease). In the control group of comparison were 26 patients (median age 13.5 (10-16) years) with benign tumors of similar localization. The vascular patterns of the soft tissue component of the tumor were evaluated in the modes of color Doppler mapping and pulsed wave Doppler, indices - of resistance, pulsative (RI, PI) and volume blood flow (Q) on common femoral artery (CFA) for affected and healthy limbs were calculated. The cardiac output (CO) was determined by echocardiography assay.
Results

In most cases, the ultrasound study demonstrated an extraosseous component of the tumor, which was adjacent to the affected bone (Fig. 1). The volume median of malignancies was 239 ml (lower quartile 112 ml, upper quartile 365 ml). Tumor vascularization by color Doppler was determined in most cases (Fig. 2). There were no differences in the degree of vascularization of Ewing’s sarcoma in comparison with osteosarcoma in these studies. Through the aid of three-dimensional reconstruction, vascular channel tumors were found to have the chaotic spatial arrangement of vessels of small-medium caliber (Fig 3). Vascularization of the tumor was presented in the form of randomly arranged polymorphous vascular structures of 0,5 - 2 mm caliber. The resistance index for the intratumorally vessels have been varied (0,70±0,26). The curves Doppler of blood flow for CFA of the affected limbs (in contrast to the non affected limb) in most cases have been with high amplitude and above zero line during the pulse cycle (Fig 4,5). This coincides with data of Bramer J.A. et al (2004) [3]. Blood flow in the CFA differed on quantitative characteristics in the affected and healthy limbs in patients with OS and ES too. At the same time, between these groups (OS and SE) there were no statistically significant differences in age, CO and in all the other studied regional indicators. For sarcomas unequivocally, directions of affected limbs change characterized by an increase in Q and by a decrease in RI, PI for CFA blood flow compared with contralateral side and compared with the affected limb of patients with benign tumors (Fig. 6). For example, the volume blood flow of the CFA to the affected limb was 885 ± 324 ml / min, and for a healthy limb - 424±138 ml / min (p<0001). For pulsative index respectively there was falling on the side of lesion - 2,60±0,90 compared with healthy limbs - 5,17±0.90 (p <0001). Smaller values of Q in the CFA of the non affected limbs in the group of the sarcomas patients in comparison with group of benign tumors (p<0,001) can indicate the nature of the regional hemodynamics disorders (redistribution) in the patients with sarcomas. In the sarcomas groups there was a correlation between the volume of tumor and major parameters of hemodynamic of the affected limb (Q, % decrease in RI) r=0,37-0,43 (p<0,05) and to central hemodynamics (CO) r=0,56 (p<0,05). For the non affected limbs in both the sarcomas and benign tumors group, significant differences in the RI were not detected. When studying the parameters of the central hemodynamics in this work identified elevated (p<0,05) relative to group comparison values CO in patients with sarcomas.
Fig. 0: Transverse scan at the lower third of the tibia on the left in comparison with healthy limb in patient with Ewing's sarcoma. There are Irregular shaped, fuzzy contours, heterogeneity of echostructure of the tumor, the violation of the integrity of the affected bone

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**Fig. 0:** Duplex scanning in the affected area (lower third of the femur on the right) patient with osteogenic sarcoma. Tumor vascularization in the form of randomly distributed polymorphic vascular structures

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Fig. 0: Reconstruction of vascular bed (osteogenic sarcoma)

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**Fig. 0:** Blood flow in CFA to the non affected limb in mode color and pulsed wave Doppler in a patient's with localized sarcomas at the bottom 1 / 3 of the femur on the left side

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**Fig. 0:** Blood flow in CFA to the affected limb in mode color and pulsed wave Doppler in a patient's with localized sarcomas at the bottom 1/3 of the femur on the left side

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**Fig. 0:** A comparison of the relative changes in volume blood flow (Q) and index of resistance (RI) in affected limbs for the CFA of malignant (mal) and benign (ben) tumors

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Conclusion

From the data obtained by using Doppler technique describing marked: circulatory bed of the tumor itself (features of vascular patterns, the value of resistive index); functional restructuring of the state of the vascular bed throughout the affected extremity (the value changes pulsative index, volume blood flow for CFA); and, systemic effects of the tumor on the body (changes in CO). Such systematic deviations can help diagnose the restructuring of central and regional hemodynamics of the patient in time when the clinical manifestations of malignant tumor growth are non specific, and there is no unambiguous interpretation of radiological findings. These data at the initial stage of diagnosis together with by X-ray methods will permit better identification of patients with signs of malignant lesions of the lower limbs.
References


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