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Possibilities of spatial imaging of carotid arteries pathologies in Power-Doppler US

Conventional duplex and Color, Power-Doppler US is today the most commonly used non-invasive method of assessing diseases of carotid arteries (3). Other methods include spiral CT angiography and MRI angiography (2). Side by side with selective angiography these techniques give new options in the assessment of vascular diseases (3). MRI angiography and selective angiography are techniques of choice for visualizing ulcerating atheromas and vessel narrowings.

The aim of the study was to assess the value of spatial Power-Doppler US reconstructions in examining pathologies of carotid arteries and determine its role in the diagnostic algorithm.

MATERIAL AND METHOD

3D Power-Doppler US was performed in 19 patients with pathologies of carotid arteries qualified for surgical treatment on the basis of Color-Doppler examination. The exam was done with Sonoline Elegra Aparatus by Siemens. Digital data of 2D sections stored in the computer's memory gave spatial pictures. The data were collected in Power-Doppler exam by a uniform shift of the head on a given segment in definite time (i.e.: 10cm/20s). Spatial imaging of the vessels was obtained by means of shading and changes of colour intensity while imaging surfaces. 3D pictures were correlated with 2D US examinations and operative findings.

RESULTS

In 3 cases the narrowing of internal carotid artery had critical character (Fig. 1). Complete impatency of the artery was found twice (Fig. 2). Different degrees of narrowings of flow lumen were most frequently observed (Fig. 3).

Irregularities of vascular surface reconstructed in 3D US with its narrowed lumen were caused by both atheromas and parietal clots (Fig. 4). Atheroma localized on one side of the vessel produced irregular asymmetric contours of the stenotic segment (Fig. 3). Segmental concentric narrowings, however, occurred in 2 patients.

In 4 cases of atheroma its excavation was shown, in 3 cases spatial US picture revealed the presence and localization of a polypoidal clot forming intravascular defect of the filling. Spatial pictures determined the geometry of division of common carotid arteries, in 2 cases besides anomalies of its bifurcation a segmental narrowing of internal carotid artery was shown (Fig. 5).

In 3 cases internal carotid artery formed an angular refraction (Fig. 6). Both before and at the site of refraction asymmetric narrowing was visualized. These changes caused slowing down of blood flow. In obtaining axial sections in optional planes the use of the spatial matrix was essential (Fig. 7).

DISCUSSION

Advantages of 3D US are not only associated with determining the degree of narrowing but also with revealing morphologic features of atheroma, its configuration surface ulcerations and calcifications. Dystrophic calcifications of plaques are frequent in forming clots. It is believed that narrowings of internal carotid artery amounting to over 70% of its lumen is an indication for surgical treatment (1). Similar indications are given by atheromas, especially with ulcerations forming parietal clots, bleedings or cholesterol embolisms. Echogenicity of atheromas correlates with their histopathology and collagen content. Hyperechogenic plaques with acoustic shadowing corresponded with calcifications. Fibrous--fatty plaques, often nearly homogenous, show little homogenicity. They can be isoechogenic with flowing blood. It is suggested that heterogenous plaques with fields of decreased echogenicity corresponded with hemorrhages to their inside (1).

Atherosclerosis like thrombosis gets usually localized at the level of bifurcation of common carotid artery. Coexistence of thrombotic changes and plaque ulcerations is emphasized (4, 5). Clots are usually formed in the field of maximal narrowing. Atherosclerosis also results in the lengthening of the vessel and twisted course or refractions.

Plaque ulcerations constitute an anomaly difficult to detect on US (1, 6). In the material under discussion they were found in 10 patients (52.6%). It is suggested that the detection of ulceration depends on the degree of lumen narrowing. Castaneda (1) found plaque ulceration in 77% patients with lumen narrowing up to 50% and 48% in narrowings over 50%. This suggests easier detection of ulceration in narrowings of a smaller degree.

CONCLUSIONS

1. Power-Doppler 3D US perspectively visualizes the configuration of carotid vessels and the range of their pathology facilitating understanding of the extent of changes and mutual topographic relationships.

2. Spatial imaging side by side with the degree of carotid arteries narrowing allowed to visualize atheromas and ulcerations of their surfaces.

3. 3D reconstructions should supplement standard US examination.

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EXPLANATION TO FIGURES

Fig. 1. Critical narrowing of the right internal carotid artery caused by atherosclerotic plaques (A – common carotid artery, V – jugular internal vein).

Fig. 2. Complete impatency of the right internal carotid artery (A – common carotid artery).

Fig. 3. Irregular narrowing of the common carotid artery at the level of the bulb, narrow flow lumen in the internal carotid artery (A – common carotid artery).

Fig. 4. Irregular segmental narrowing of the right internal carotid artery in the initial part directly over the bulb of the common carotid artery caused by the presence of both plaques and parietal clots.

Fig. 5. Segmental narrowing of the internal carotid artery (arrow), anomaly of bifurcation of the common carotid artery, internal carotid artery leaves in the postero-internal part of the bulb (A – common carotid artery, V – jugular internal vein).

Fig. 6. "Kinking" – angular refraction of the left internal carotid artery (A – common carotid artery).

Fig. 7. Spatial matrix is a basis for obtaining axial sections in optional planes.

SUMMARY

The aim of the study was to assess the value of Power-Doppler US spatial reconstructions in examining pathologies of carotid arteries for determining its role in the diagnostic algorithm. 3D Power-Doppler US reconstructions were performed in 19 patients with pathologies of carotid arteries qualified for surgical treatment on the basis of Color-Doppler examinations. Digital data of 2D US sections secondarily gave spatial pictures.

Most frequently, 14 times, different degrees of carotid artery stenosis were found, in 3 cases critical, and complete impatency was observed twice. The narrowings were caused by both atheromas and parietal clots. In 3 cases the internal carotid artery formed an angular refraction. Spatial pictures also determined the geometry of division of common carotid arteries.

It was found that Power-Doppler 3D US perspectively visualizes the configuration of carotid

vessels and the range of their pathology facilitating understanding of the extent of changes and mutual topographic relationships. Spatial imaging let visualize atheromas and ulcerations of their surfaces besides the degree of carotid arteries narrowing.

Możliwości przestrzennego obrazowania patologii tętnic szyjnych w Power-Doppler USG

Celem pracy jest ocena wartości przestrzennych rekonstrukcji Power-Doppler USG w badaniu patologii tętnic szyjnych dla określenia jej miejsca w algorytmie diagnostycznym. Rekonstrukcje 3D Power-Doppler USG wykonano u 19 chorych z patologią tętnic szyjnych, zakwalifikowanych na podstawie badań Color-Doppler USG do leczenia operacyjnego. Z danych cyfrowych przekrojów dwuwymiarowych USG wtórnie otrzymano obrazy przestrzenne.

Najczęściej, 14-krotnie, stwierdzano różnego stopnia zwężenie tętnicy szyjnej wewnętrznej, w 3 przypadkach krytyczne, a całkowitą niedrożność dwukrotnie. Powodowały je zarówno płytki miażdżycowe, jak i zakrzepy przyścienne. W trzech przypadkach t. szyjna wewnętrzna tworzyła kątowe załamanie. Obrazy przestrzenne określały także geometrię podziału tt. szyjnych wspólnych.

Stwierdzono, że Power-Doppler 3D USG uwidacznia perspektywicznie konfiguracje naczyń szyjnych oraz zakres ich patologii, ułatwiając zrozumienie rozległości zmian i wzajemnych stosunków topograficznych. Obrazowanie przestrzenne obok stopnia zwężenia tętnic szyjnych pozwalało na uwidocznienie płytek miażdżycowych oraz owrzodzenia ich powierzchni.

Fig. 1

Fig. 2

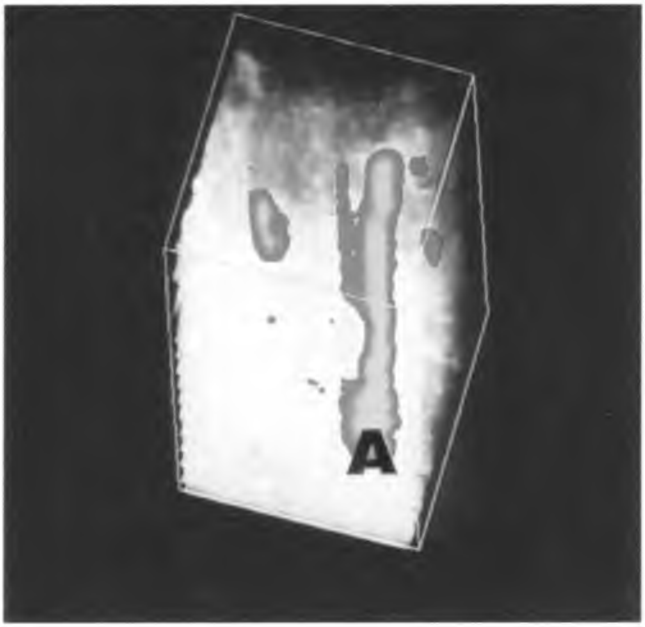

Fig. 3

Fig. 4

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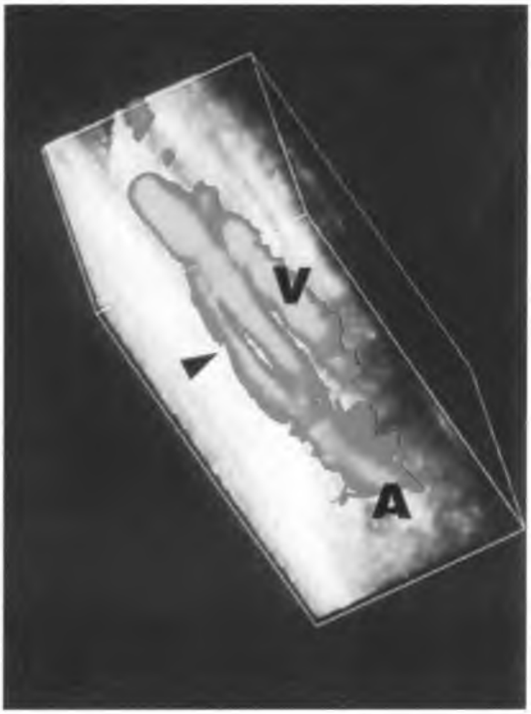

Fig. 5

Fig. 6

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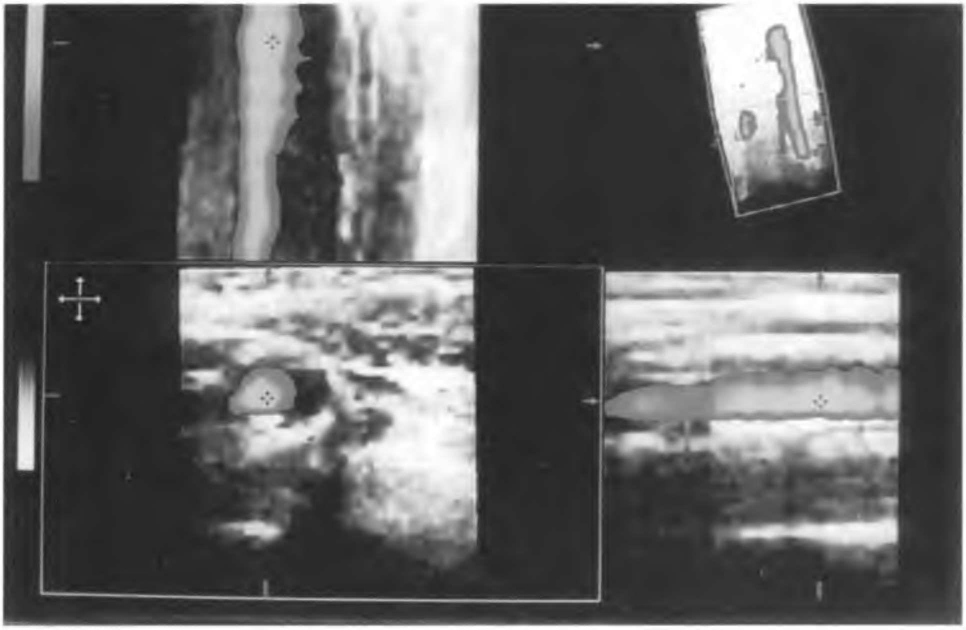

Fig. 7

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