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VIEWING VERTEBRAL ARTERIES BY DUPLEX SCAN: WHAT TO EXPECT

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A b s t r a c t. In vertebral arteries (v.a) most stenoses occur at their origins. Ultrasound studies with a 7,5 MHz sector duplex-probe are able to reveal the origins in 63—68% of the right, in 43—62% of the left vertebral arteries (men<women), whereas the prevertebral and the intertransversal parts $C_{5/6}$—$C_{3/4}$ are visualized in 70—90%. The mean cumulative lumen of both v.a. increases by age from 6,0 mm (age<30) to 7,9 mm (age>80) with a clear predominance of the left v.a. in 33%, of the right v.a. in 17%. Hypoplasia of one or both v.a. is present in 5,2%. In a sample of 1131 patients pathological findings occured in 11% of the vertebral arteries (stenoses or occlusions, steal phenomena) and in 16% of the carotid arteries (stenoses 50%, occlusions). In 42% of the cases with infarctions in the vertebro basilar supplied territories pathological duplex findings were present, similary in 20% of infarctions in the carotid supplied territories, and in 15% of vertigo, but also in 62% of patients with peripheral vascular disease without neurological signs or symptoms — versus only in 3% of control-patients of similar age without neurological or peripheral vascular disease.

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ВИЗУАЛИЗАЦИЯ ПОЗВОНОЧНЫХ АРТЕРИЙ МЕТОДОМ ДВОЙНОГО СКАНИРОВАНИЯ

Р е ф е р а т. В позвоночных артериях стенозы в большинстве случаев возникают у их начала. Ультразвуковые исследования с помощью зонда в частотном режиме 7,5 МГц позволили выявить устье правых позвоночных артерий у 63—68% и левых — у 43—62% обследованных, тогда как их превертебральные и межпоперечные отделы $C_{5/6}$—$C_{3/4}$ визуализировались у 70—90%. Гипоплазия одной или обеих позвоночных артерий выявлена у 5,2% обследованных. У выборочно взятых 1131 пациента патологические изменения в позвоночных артериях выявлены в 11% (стенозы, окклюзии, синдром обкрадывания) наблюдений, в 16% — установлены изменения в сонных артериях (стеноз — 50%, окклюзии). В 42% случаев ишемического инсульта (инфаркт) в вертебробазилярном бассейне имели место патологические изменения, выявленные методом двойного сканирования. Подобные нарушения выявлены в 20% случаев инсульта в бассейне сонных артерий, в 15% случаев головокружений, а также у 62% пациентов с заболеваниями периферических сосудов без неврологических синдромов, и напротив, — только у 3% в контрольной группе здоровых лиц.

М.Салашек

УМЫРТКА БАГАНАСЫ АРТЕРИЯСЕН ИКЕЛЕ СКАНИРЛАУ ЮЛЫ БЕЛӘН ВИЗУАЛИЗАЦИЯЛӘҮ (КҮЗӘТҮ)

Күпчелек очракта умыртка баганасы артерияләре тараю (стеноз) аның очыннан башлана. 7,5 МГц ешлык тагы режимлы зонд ярдәмендә үткәрелгән ультратавыш өйрәнүләр тикшерелгәннәрнең 63—68 процентында ун як умыртка артерияләре авызын һәм 43—52 процентында сул ягын ачыклау мөмкинлеген бирде. Ә аларның $C_{5/6}$(V—VI)—$C_{3/4}$(III—IV) превертебраль һәм аркылы булекләре 70—90 процент тикшерелгәннәрдә чагылыш таба. Бер яисә ике умыртка багана артериясе гипоплазиясе тикшерелгәннәрнең 5,2 процентында ачыкланды. Сайлап алынган 1131 пациентның 11 процентында умыртка баганасы артериясендә, 16 процентында йокы артерияләрендә үзгәрешләр булуы ачыкланды. Ин фарктның (ишемия инсультының) 42 проценты очрагында икеле сканирлау ысулы белән вертебробазилляр бассейнда патологик үзгәрешләр, нормадан тайпылышлар булуы ачыкланды. Мондый тайпылышлар йокы артериясе бассейны инсультының 20 процент очрагында, баш әйләнүнең 15 процент очрагында, периферик тамырлары (неврология билгеләресез) чирле 62 процент пациентта һәм, киресенчә, бары 3 процент саламәт кешеләрдә булуы ачыкланды.

Comparing the most likely sites of stenotic lesions in the carotid and the vertebral arteries, there is one important difference: in the carotid arteries most stenoses occur at the level of the bifurcations, whereas in the vertebral arteries stenoses must be expected mainly at their origins [3,4].

The carotid bifurcations are easily accessible by ultrasound: they are close to the surface, their diameter is large, and there is no bony structure in the way of the ultrasonic beam. On the other hand, the origins of the vertebral arteries and their prevertebral parts lie deeper below the surface and, at times, they are already behind the clavicular bones. Therefore the examination of these parts of the arteries can be difficult, especially when using a relatively large transducer.

For our investigations Diasonic RA 1 and DRF-300 sector-scanners with 7,5 MHz duplex probes were used. Distances were calculated by readings between cursor positions; because of an axial resolution of the probes of only 0,3—0,4 mm, these measurments could only be approximations.

NORMAL FINDINGS

Examining 122 successive patients (61 male, 61 female), the origins of the vertebral arteries were visualized in about 50% of the men and 65% of the women — the sex difference probably being the result of the smaller necks most women had. The rest of the prevertebral parts and the further course of the vertebral arteries in the intertransversal spaces $C_{5/6}$ and $C_{4/5}$ was visible in more than 90% of the cases; $C_{3/4}$ could be inspected in about 70 to 80% and $C_{2/3}$ in about 10 to 30% (fig. 1,2). In only 1,4% of 1131 patients no part of a vertebral artery could be visualized, either on one or on both sides. Similar findings were reported by Touboul et al. and Visona et al. [7,8].

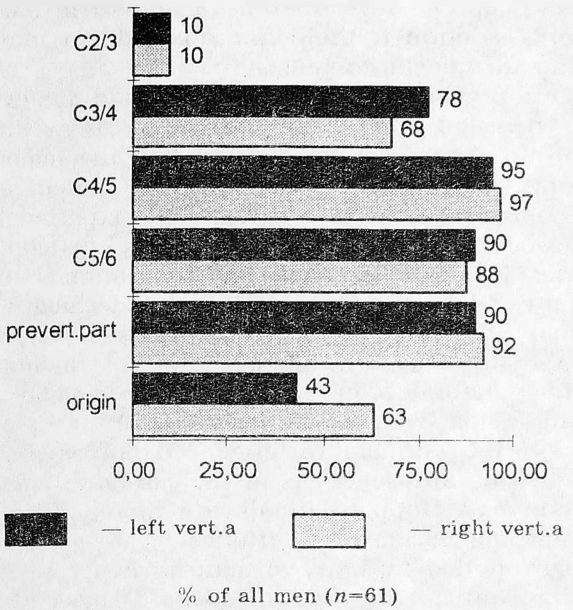

Fig. 1. Vertebral arteries. Visibility by duplex-scan. Male

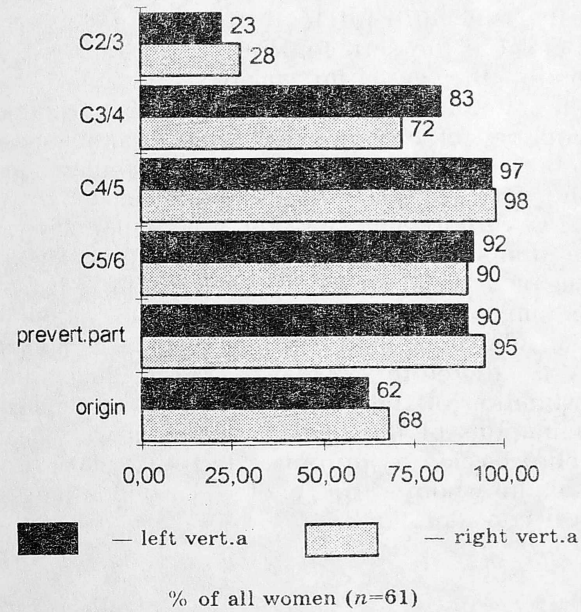

Fig. 2. Vertebral arteries. Visibility by duplex scan. Female

The *lumina* of the vertebral arteries differ more between right and left than in the carotid arteries. In about one half of 1131 patients the lumina of both vertebral arteries were identical within 0,5 mm. The left artery was dominant in 33%, the right artery in 17% of the cases. A left/right-difference of more than 1 mm in lumen was found in 33% (24% l.r., 9% r.l.). Hypoplasias (lumen equal or less than 1,5 mm) were seen in 3,1% of the right, 1,9% of the left vertebral arteries: 3 of 1131 patients (0,3%) had hypoplasias of both vertebral arteries. The *mean cumulative lumen* of both vertebral arteries increased by age from 6,0 mm in patients younger than 30 years to 7,9 mm in patients older than 80 years without a significant sex difference (+/−1,1 mm for each agegroup) (fig. 3).

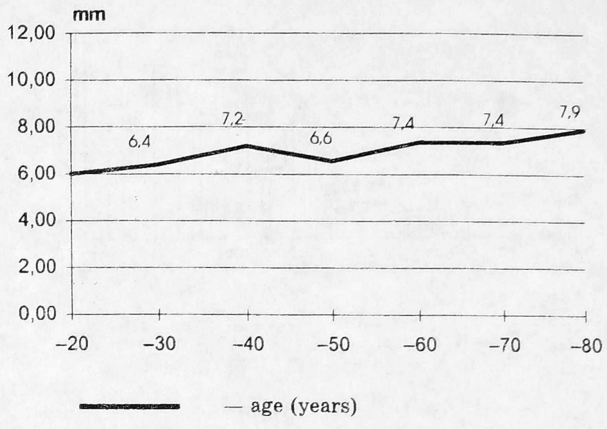

Fig. 3. Cumulative mean lumen of both vertebral arteries

PATHOLOGICAL FINDINGS

Hemodynamically important *stenoses* of the vertebral arteries were found only at their origins. Some plaques were also visualized in the prevertebral, few in the intertransversal parts. In most cases the degree of stenosis could not be determined, as sufficient B-mode cross-sections were not possible; estimations had to rely on the doppler-signal. For this reason all clearly visible plaques are included under the term "stenosis" in the following data.

Occlusions of vertebral arteries can be difficult to demonstrate, since the diagnosis must rely on a missing doppler signal in several parts of the artery, and reopenings by collateral pathways cannot always be visualized. Angiography was performed in 4 of our 7 cases, confirming the duplex findings.

Vertebral steal-phenomena can easily be detected by ultrasound-duplex-scan (table 1).

Table 1

127 cases of stenoses, occlusions and vertebral steal in 1131 patients

	Stenoses	Occlusions	Vertebr. steal
Right vertebr.a	51	3	7
Left vertebr.a	38	3	11
Both vertebr.a	13	1	—

The percentage of pathological findings in the vertebral arteries increased by age from 3% in patients in their 4th decade to 16% in those over 80 years of age. In the same group of patients, carotid stenoses of more than 50% occured somewhat more frequently in most age groups (fig. 4).

Of all 1131 patients, 16% had at least one carotid-stenosis of more than 50%, versus 11% of pathological vertebral findings. Among specific diseases *intracranial infarctions in the vertebro-basilar territory and peripheral vascular disease* (without neurological signs or symptoms)

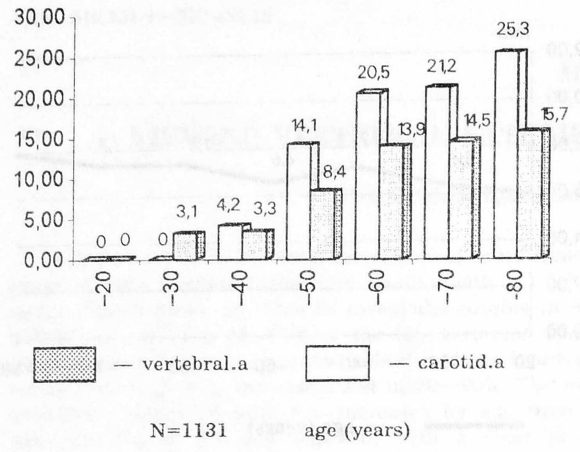

Fig. 4. Vertebral a: steal phenomena. all stenoses. Carotid a stenoses >50%

were particularly associated with pathological vertebral findings. It is doubtful whether *vertebral hypoplasias* are of any diagnostic importance; yet they seem to coincide more frequently with cases of infarctions or transitory disturbances in the vertebro-basilar supplied areas of the brain (table 2).

DISCUSSION

Arteriosclerotic changes in the vertebral arteries will rarely lead to surgical intervention; however their presence can influence the decision whether to treat carotid stenoses conservatively or surgically. Although conventional doppler sonography can already reveal many hemodynamically significant stenoses at the origins of the vessels [5], duplex-scanning will help to identify the vessels more clearly and to place the sample volume of the pulsed-doppler system right at the area of interest. The usefulness of this approach has already been described by others [1,2]. Our investigation of more than 1000 patients confirmed their findings, adding interesting diagnostic details.

Our previous studies by ultrasound duplex scan revealed that in 88% of the cases with a carotid-stenosis of more than half the lumen on one side, atheromatosis was also present in the contralateral carotid artery. We expected a somewhat lower coincidence in the vertebral arteries [6]. This assumption was confirmed by the present ultrasound study. We decided to compare the percentage of carotid stenoses of more than 50% with all pathological findings in the vertebral arteries including non-stenotic plaques. This seems to be justified, because plaques in the vertebral arteries are not as easy to detect by ultrasound as in the carotid arteries: B mode and Doppler signals are more difficult to interpret, because the arteries lie deeper and are surrounded by bony structures; hence small plaques will not be recognized as easily in the vertebral as in the carotid arteries. Cross sections of the vertebral arteries will seldom reveal the exact degree of stenosis. Plaques of low echo density, even difficult to distinguish in the vessels close to the surface, are rare in the duplex scans of the vertebral arteries.

In spite of these restrictions we demonstrated a tendency of high proportions of pathological vertebral findings in patients having infarctions of the posterior parts of the brain and in cases of TIA, vertigo and peripheral vascular disease without neurological signs or symptoms. Hypoplasia of a vertebral artery (defined by a lumen <1,5 mm) was also more frequent in vertebro-basilar infarctions than in other diagnostic groups.

We therefore propose to include the investigation of the vertebral arteries in duplex examinations of the neck of patients with clear vertebro basilar symptoms, and also in every person in whom surgery of a carotid artery is under consideration.

Table 2

Pathological duplex-scans of carotids (stenoses >50%), vertebral arteries (all stenoses, steal-effect), and vertebral hypoplasias in several identical diagnostic groups (% of each diagnostic group)

	n	Carotid arteries stenoses >50%	Vertebral arteries steal, all stenoses	Vertebral hypoplasias
All patients	1131	16,2	11,2	5,3
Control-pat	123	0,8	3,3	7,3
Infarction, vert. bas.	19	10,5	42,0	15,8
Infarction, carotid	193	31,6	9,8	4,1
TIA, vert, bas.	17	11,8	17,6	11,8
TIA, carotid	70	25,7	20,0	1,4
Visual disturbance	56	17,9	10,7	1,8
Vertigo	183	14,2	15,3	7,1
Syncope	84	13,1	2,4	7,1
Parkinson's disease	41	17,1	9,8	0,0
Psycho-organic syndrome	50	30,0	4,0	8,0
Periph. vascular disease	32	50,0	62,5	6,2

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MAGNETIC RESONANCE IMAGING IN SKELETAL MUSCLE FOLLOWING DENERVATION AND ELECTRICAL STIMULATION

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A b s t r a c t. Following chronic denervation, MRI evaluation of fast rabbit muscles revealed a distinct increase of signal intensity and T_2 relaxation time. These changes were missing or less pronounced after treatment with a new type of electrical stimulation, which previously had proved effective in avoiding muscle atrophy. One month after denervation, there was a slight increase of signal intensity as well in the stimulated as in the untreated animals, after two months, however, the increase was statistically significant only in the non-stimulated muscles. T_2 relaxation time showed a slight increase after one month of therapy, while there was a significant increase after one and two months without therapy. After 3—6 months of electrical stimulation, there was no increase of T_2 at all. The results indicate 1), that MRI can be used when monitoring stimulation effects on denervated muscle, and 2), that, for this purpose, T_2 relaxation time is more useful than signal intensity.

Т.Мокруш

ВИЗУАЛИЗАЦИЯ СКЕЛЕТНЫХ МЫШЦ МЕТОДОМ ЯДЕРНО МАГНИТНОГО РЕЗОНАНСА ПОСЛЕ ДЕНЕРВАЦИИ И ЭЛЕКТРИЧЕСКОЙ СТИМУЛЯЦИИ

Р е ф е р а т. Визуализация методом ядерно-магнитного резонанса мышц кролика с хронической денервацией на фоне голодания позволила обнаружить явное увеличение интенсивности сигнала и времени релаксации T_2. Эти изменения не наблюдались или были менее выражены после лечения электростимуляцией, которая ранее оказалась эффективной в профилактике атрофии мышц. Через месяц после денервации наблюдалось небольшое возрастание интенсивности сигнала как у стимулированных, так и у нестимулированных животных. Однако через 2 мес его возрастание было статистически значительным только в стимулированных мышцах.

Т.Мокруш

ДЕНЕРВАЦИЯ ҺӘМ ЭЛЕКТР СТИМУЛЯТОРЫННАН СОҢ СКЕЛЕТ МУСКУЛЛАРЫН ТӨШ-МАГНИТ ТИРБӘНЕШЕ ЫСУЛЫ БЕЛӘН ВИЗУАЛИЗАЦИЯЛӘҮ (КҮЗӘТҮ, ТИКШЕРҮ)

Ачлык аркасында килеп чыккан хроник денервацияле йорт куяны мускулын төш магнит тирбәнеше ысулы белән күзәтү (визуализацияләү) сигнал көченең үсүен һәм T_2 релаксация вакыты артуын тапты. Элек мускул атрофиясен (загыйфьләнүен) дәвалаганда әйбәт нәтиҗәләргә китергән электр стимуляциясе белән дәвалаганнан соң, моңдый үзгәрешләр сизелерлек киме де яисә бөтенләй күзәтелмәде. Денервация башланып, бер ай узганнан соң, стимуляцияләнгән хайваннарда да, стимуляцияләнмәгән хайваннарда да сигнал көченең бераз үсүе күзәтелә, ләкин 2 айдан үсеш бары тик стимуляцияләнгән мускулларда гына сан ягыннан сизелерлек була.

Denervation atrophy and electrical stimulation

Following chronic denervation, a lot of well known changes occur in a skeletal muscle, particularly concerning contractile properties and morphological features [6]. While contraction force decreases, the muscle fibres become smaller and histologically an increase of fat and connective tissue is found.

Despite many investigations during the last decades, the discussion on the efficacy of electro therapy in chronic denervation is still controversial. In most of the earlier irvestigations, electro therapy was found to delay, but not to avoid