THE EFFICACY OF DOPPLER ULTRASOUND ON CHRONIC SUPPURATIVE OTITIS MEDIA

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ABSTRACT

Aims: *The diagnostic techniques used in the diagnosis of lateral sinus thrombosis are invasive and pose a risk of stroke. For this reason, we aimed to evaluate the efficiency of Doppler ultrasonography, a simple, fast, and non-invasive technique in this field.*

Materials and methods*: Patients presenting at our clinic with one-sided, chronic suppurative otitis media were included in the study. Internal jugular vein and internal carotid artery Doppler tests were conducted on the patients. The healthy ears of the patients were used as the control group. The values were compared statistically.*

Results*: A total of 40 patients were included in the study 17 male (42.5%) and 23 female (57.5%). Seventeen patients had suppurative otitis media with cholesteatoma, and 23 patients had suppurative otitis media without cholesteatoma. According to Doppler ultrasonography parameters, no statistically significant differences were observed. However, when the chronic suppurative otitis media patients were compared to those without cholesteatoma, the internal jugular vein diameter was found to be reduced significantly in the group with cholesteatoma (p=0.047).*

Conclusion*: The results of our study suggest that Doppler ultrasonography can be considered as a useful, fast, easy, and non-invasive method in the prognosis of cases with suspected lateral sinus thrombosis.*

Key words*: Chronic suppurative otitis media, Doppler ultrasonography, Lateral sinus thrombosis.*

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Introduction

The definition of a complication of otitis media is a spread of infection beyond the pneumatized area of the temporal bone and the associated mucosa[1]. Thrombophlebitis of the venules of the adjoining cranial bones, bone erosion by pressure or enzymatic actions, preformed pathways, and hematogenous spread are some of the pathways of extracranial and intracranial complications[2]. Complications of chronic suppurative otitis media can be classified as either extracranial or intracranial[3,4]. The reported extracranial complication (EC) and intracranial complication (IC) rates related to chronic suppurative otitis media vary from 0.5% to 1.4% and from 0.3% to 2.0%, respectively[5]. The most common EC include facial paralysis, subperiosteal abscess, mastoiditis, and labyrinthitis, with a reported incidence of 13% to 58%, 40% to 68%, 14% to 74%, and 7% to 34% of each EC, respectively[5]. The most common IC are meningitis, cerebral abscess, lateral sinüs thrombosis, extradural abscess, otic hydrocephalus, and encephalitis, with a reported incidence of 21% to 72%, 18% to 42%, 2% to 26%, 7% to 16%, 5% to 11%, and 2% of each IC, respectively[5].

Lateral sinus thrombosis (LST) is a rare, but feared, intracranial complication that develops due to otitis media[3]. LST, which generally develops connected to the mastoid, forms when the infection reaches the sigmoid sinus as a result of bone necrosis occurring over it. Inflammation occurs when the microorganism reaches the sigmoid sinus and mural thrombus occurs when the blood elements accumulate in the sinus. This thrombus can cause thrombi in the cavernous sinus by moving upwards with the

help of the petrous sinus, and in the internal jugular vein (IJV) by moving through the jugular foramen[6].

LST may not produce clinical symptoms, but if a cerebral edema occurs as a result of increasing intracranial pressure due to the obstruction of intracranial venous drainage, it could be fatal[6]. In rare cases, emboli may result in significant morbidity and mortality by showering to distant locations[7]. Mortality rates for LST range from 5% to 10%[8].

The techniques used in diagnosing LST are invasive and pose a risk of stroke[9]; therefore, there is a need for less invasive and easier methods for the diagnosis of LST, a complication with high mortality. As such, we aimed to evaluate the efficiency of Doppler ultrasonography (USG), which is a simple, fast, and non-invasive technique in this area. USG was used to investigate the diameters and flow rates of the IJV and internal carotid artery (ICA) in patients with chronic suppurative otitis media (CSOM). We compared the values with those of healthy ears, and presented the differences between CSOM patients with and without cholesteatoma.

Material and method

The study was approved by the local ethics committee of the department and carried out in accordance with the Declaration of Helsinki as amended in 2008. Forty patients admitted to the Department of Otorhinolaryngology, Head and Neck Surgery at Dicle University Hospital between April 2011 and April 2012 with the diagnosis of one-sided CSOM, who had not previously undergone ear surgery, were included in the study.

Although the duration of the ear illness varied from three months to ten years in our cases, a flare of 1-6 weeks and medical treatment, usually started at other centers, were common in their histories. The patients included in the study suffered from intermittent ear flux and hearing loss. In the otomicroscopies of these patients, those with granulation in the middle ear, polyp filling the external earway, flux, and cholesteatoma or suspected cholesteatoma in addition to perforation of the eardrum, were evaluated as CSOM with cholesteatoma. The patients whose ear flux healed with medical treatment and who had eardrum perforation in the otomicroscopy were classified as CSOM without cholesteatoma. The healthy ears of the patients included in the study were evaluated as a control group. The demographic traits, admission symptoms, otoscopic examination symptoms, and audiologic values were recorded in detail.

Otorhinolaryngological examinations, with specific attention to audiometry, were performed in all patients. For objective hearing assessment according to the guidelines of the American Speech-Language-Hearing Association, pure tone audiometry was conducted on all participants in sound-treated booths. The pure-tone average of hearing thresholds at 0.5, 1, 2, and 4 kHz was calculated (arithmetic mean). Severity of hearing loss was classified into four categories, according to the degree of hearing loss, as follows: very slight hearing loss (15-30 dBHL), slight hearing loss (30-50 dBHL), moderate hearing loss (50-70 dB), and severe and very severe hearing loss (70 dBHL and above).

The specialist who had conducted the other tests also recorded all patients' ICA and VJI diameters, flow, and speed rates, using a Toshiba Aplio XG USG, 7500 MHz linear transducer with the patient in the supine position, head at middle line and turned to the other side.

Statistical methods

All data was entered into Statistical Package for the Social Sciences 15.0. The averages and frequency distribution were examined. The normalcy of numeric variables was investigated. Student's T test was used in the normally distributed variables, and a Mann-Whitney U test was used in the others. A chi square test was used in analyzing the categorical variables.

A Kruskal-Wallis test was used in the analysis of the Doppler USG values to determine if there was any difference between hearing loss groups. A Mann-Whitney U test was used in the within group comparisons when there was a difference between groups. $P<0.05$ was considered significant.

Results

Of the 40 patients included in the study, 17 (42.5%) were male and 23 (57.5%) were female. The average age was 31.30±12.10. Twenty-three patients were diagnosed with CSOM with cholesteatoma, and 17 were diagnosed without cholesteatoma. In the patients with CSOM with cholesteatoma, the right ear was affected in 12, and the left ear in 11. In the otoscopic examination, five

of the patients with an affected right ear exhibited granulation tissue, and seven exhibited cholesteatoma. Of the patients with an affected left ear, four exhibited granulation tissue, and seven exhibited cholesteatoma. In the patients with CSOM without cholesteatoma, the right ear was affected in nine, and the left ear in eight.

Of the 23 patients diagnosed with CSOM with cholesteatoma, 13 had conductive type hearing loss (HL) and ten had mixed type HL. Of the 17 patients diagnosed with CSOM without cholesteatoma, nine exhibited conductive type HL and eight exhibited mixed type HL. According to the hearing loss scale, it was seen that hearing loss increases with age.

According to the IJV and ICA Doppler USG patient results, when their venous and arterial vascular flow and speed were compared, no statistically significant differences were detected between the patient group and the control group ($p>0.05$). However, when the groups with and without cholesteatoma were compared, the IJV vascular diameter was found to be significantly smaller in the group with cholesteatoma ($p<0.05$) (Table 1).

	CSOM with cholesteatoma	CSOM without cholesteatoma	p
IJV flow	0.47±0.28	0.41±0.20	0.538
IJV speed	39.89±23.22	44.69±17.65	0.305
IJV diameter	6.93±2.62	5.39±1.50	***0.047***
ICA flow	0.40±0.13	0.40±0.17	0.978
ICA speed	69.80±23.00	70.35±25.07	0.967
ICA diameter	4.49±0.51	4.63±0.57	0.546

Table 1: Comparison of vascular parameters between the CSOM with cholesteatoma group and CSOM without cholesteatoma group.
IJV: internal jugular vein, ICA: internal carotid artery, CSOM: chronic suppurative otitis media

	IJV flow	IJV speed	IJV diameter	ICA flow	ICA speed	ICA diameter
VSHL	0.29±0.85	35.64±13.69	6.36±1.77	0.50±0.20	74.20±26.62	4.85±0.60
SHL	0.45±0.22	41.69±22.74	6.48±2.28	0.35±0.80	73.29±19.02	4.28±0.35
MHLS	0.47±0.35	46.52±24.62	5.14±1.20	0.33±0.80	64.93±23.63	4.51±0.50
SVSHL	0.54±0.27	43.50±23.15	7.06±3.51	0.48±0.18	65.51±30.46	4.80±0.61
p	0.143	0.79	0.446	0.051	0.564	0.057

Table 2: Evaluation of vascular parameters based on hearing loss values .
VSHL: very slight hearing loss, SHL: slight hearing loss, MHLS: moderate hearing loss, SVSHL: severe and very severe hearing loss, IJV: internal jugular vein, ICA: internal carotid artery

No statistically significant differences were observed between the IJV and ICA Doppler USG parameters in regard to the patients' hearing loss values (Table 2).

Discussion

Complications from CSOM have decreased drastically nowadays, due to the widespread use of strong, wide-spectrum antibiotics[10-11]. However, using antibiotics causes the classic symptoms of the complications to become indistinct, so the possibility of complications is often overlooked and they cannot be recognized soon enough, leading to morbidity and even mortality, due to late treatment. This is why life-threatening LST cases are still being reported.

According to the literature, CSOM complications are more common in young and middle-aged adults[12-13] and in the male gender[14-15]. Yağiz et al.[15] reported that the ear in which the complications developed was distributed evenly, but Bradley et al.[16] reported that complications are more common in the left ear. The average age of the patients participating in our study was 31.30±12.10, 23 (57.5%) were women, and the right ear was affected in 22 (55%) patients.

While meningitis is the most common intracranial complication reported in the literature (34-77%), the position of LST in the ranking varies[11,15]. Yağiz et al.[15] found in a study that brain abscess and lateral sinus thrombosis have increased in number and ratio since the middle of the 1990s in the distribution of intracranial complication to years. It is also interesting that the study by Osma et al.[3], from our region, reported meningitis as the most common intracranial complication, while the study by Yorgancılar et al.[17], from the same center, reported LST as the most common one. The fact that LST ranks highly in the literature studies in our region, despite its decreasing frequency, compelled us to use an efficient diagnosis method.

Cholesteatoma is an important reason for complications arising secondary to CSOM[3,18]. Arbağ et al.[12] detected cholesteatoma in 79.3% and granulation tissue in 43.8% of cases with complications due to CSOM. Kangsanarak et al.[11] found cholesteatoma in 80%, and Osma et al.[3] found granulation in 21.5% and cholesteatoma in 78.5%. In the study by Samuel et al.[19], they found only granulation tissue in 60% of mastoids with intracranial complications.

After otoscopic examination of the patients with CSOM that were included in our study, we found that 61% had cholesteatoma and 39% had granulation tissue. The fact that a difference in the IJV diameters was observed when patients with and without cholesteatoma were compared with Doppler USG can be considered significant at this point.

The diagnosis of LST is generally difficult, because clinical and laboratory data are considered non-specific and inadequate[20], which is why radiologic examination is important in these patients[21]. Computed Tomography (CT) scans have always been the basis of initial investigations and are important for demonstrating diseases in the mastoid and adjacent parts of the cranial cavity[22]. Contrast-enhanced CT scan is particularly important in demonstrating venous thrombosis by showing "empty delta signs," an empty triangular appearance of thrombosis surrounded by contrast-enhanced dura mater[22]. However, these CT symptoms may not be seen in all thrombi[22. It has been shown that Magnetic Resonance Imaging is more sensitive than CT imaging in detecting LST[21]. Magnetic Resonance Venography is considered a very accurate method in detecting LST, but it is an invasive procedure that carries the risk of stroke by displacing the thrombus[9]. In light of this information, we thought that we could use Doppler USG, which is easy and reliable, to detect LST in CSOM patients. At the end of the study, we detected a decrease in the IJV diameter values of the patients with CSOM with cholesteatoma, compared to the ones without cholesteatoma. This result shows us that Doppler USG can be used in the diagnosis of complications in patients with CSOM with cholesteatoma if LST is suspected, before using other techniques that are expensive and risky.

LST can come with its classic symptoms and findings, or it can be asymptomatic and end in mortality[13,18]. At this point, the universally accepted treatment method for LST is a combined antibiotic treatment. However, there is no consensus on the point of surgical application regarding the mastoid surgery, or the form of sigmoid sinus surgery[23-24]. The routine usage of anticoagulation for LST is arguable. Most authors state that there is no room for coagulants in the treatment of LST thrombosis[13,17]. We evaluated the Doppler USG results of CSOM patients without complications, and our expectation was to use Doppler USG for faster diagnosis of patients with LST suspicion and start the treatment plan immediately.

Because antibiotic usage suppresses symptoms and findings, the clinical table of complications changes, and it becomes difficult to diagnose. LST is often seen in long-term adult CSOM patients, and these patients take strong, wide-spectrum antibiotics for a long time. We considered using Doppler USG, an easy, cheap technique to diagnose LST earlier. According to the results of the study, we think that, due to the decrease of the IJV diameters of CSOM patients with cholesteatoma when compared to those without cholesteatoma, and due to the importance of early diagnosis, Doppler USG can be requested for the distinctive diagnosis of LST when symptoms like headaches, earaches, nausea, and fever are present, especially in patients with CSOM. However, for us to verify our results, the number of patients with more studies are needed to.

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