Ultrasound Assessment of Retina in Patients with Nonexudative and Exudative ARMD
I. Sakalauskaitė¹, R. Mikalauskaitė¹,
D. Stanislovaitytienė², B. Budienė², J. Trumpaitis²
¹Lithuanian University of Health Sciences, Medicine Academy, Lithuania
²Department of Ophthalmology, Lithuanian University of Health Sciences,
Medicine Academy, Lithuania
¹E-mail: iewaskl@gmail.com

**Introduction.** Age-related macular degeneration (ARMD) is the leading cause of irreversible vision loss in people aged 50 and older in the developed world [1]. The early clinical changes seen in ARMD, such as drusen and pigmentary abnormalities in the macula, are thought to be clinical markers of the risk of developing the late ARMD [2]. In assessment of the structural changes in retina there are some methods such as autofluorescence imaging or optical coherence tomography [3]. However, sometimes there are no possibilities to use these diagnostic tools.

Ultrasonic methods stand out in ophthalmology with good informative value among the noninvasive methods. Early detection of lesions and accurate diagnosis leads to effective assistance [4].

In the last decade, ultrasound probes with higher frequency and higher resolution have been commercialized, such as the 20 MHz probe used for eye posterior pole studies. Frequency is important in ultrasound because it is directly related to resolution and inversely related to penetration of ultrasonographic images [5].

**Aim.** Our aim was to compare B scan ultrasound signals backscattered from healthy tissues with signals from nonexudative (dry) and exudative (wet) ARMD areas.

**Material and methods.** From February 1st, 2016 to August 31st, 2016 patients were included in the study. We performed 64 patients (103 eyes) case-control study. Preliminary conclusions can be made after analyzing 60 cases with healthy tissue area (I group) compared to 30 cases with nonexudative ARMD (II group) and 30 cases with exudative ARMD (III group).

Distribution of patients by sex in 64 examined patients was 43 women and 21 men in total. All participants were above 50 years old. Average age was 74.4±11.5 years. The youngest patient was 50 years old, the oldest – 90 years old.

The ultrasound B scan system is Mentor (Advent, Norwell, MA), with mechanical scanning transducer of 12MHz, which is an original system supplemented with signal acquisition system [6]. System assures acquisition of raw ultrasound diagnostic signals with 250 MHz sampling frequency and 8 bits amplitude resolution. B scan raw signals were stored into database on computer hard disc and analyzed off-line. Analysis was performed by ophthalmologist...
using NICDIT v1.2 software. B scan raw signals were loaded into software reviewed and two regions of interest were selected manually. Both regions were of the same length (1.5 mm) in all analyzed cases. Two areas were investigated: healthy tissue area and area of ARMD zone (Fig. 1). The raw RF signals from selected regions were analysed in NICDIT v1.2 software algorithms [7].

**Fig. 1.** Photographs of the human retina performed with B scan ultrasound: healthy eye (A), early (nonexudative) ARMD (B), late (exudative) ARMD (C)

**Results.** Radiofrequency row signals were characterized with three parameters: amplitude (V), intercept (dB) and slope (dB/MHz) of approximated backscattered spectra (Tab. 1).

**Table 1.** Differentation parameters (mean, std. deviation) of B scan ultrasound signals backscattered from intraocular tissues

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Healthy tissues (I group)</th>
<th>Early (nonexudative) ARMD (II group)</th>
<th>Late (exudative) ARMD (III group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B scan amplitude, V</td>
<td>0,056±0,029</td>
<td>0,077±0,0327</td>
<td>0,088±0,041</td>
</tr>
<tr>
<td>Spectral intercept, dB</td>
<td>-10.137±5,755</td>
<td>-4,266±5,542</td>
<td>-6,570±6,339</td>
</tr>
<tr>
<td>Spectral slope, dB/MHz</td>
<td>-2,064±0,515</td>
<td>-2,387±0,493</td>
<td>-2,036±0,604</td>
</tr>
</tbody>
</table>

The comparison of amplitude in exploratory groups revealed that there was no significant difference observed between II group and III group (mean difference 0,011±0,008, p=0,634). The significant differences were revealed comparing I group and III group (mean difference 0,032±0,007, p=0,0) and I and II group (mean difference 0,021±0,007, p=0,012). The largest B-scan amplitude was observed in exudative ARMD group (0,088±0,041 V), the middle B-scan amplitude - in nonexudative ARMD group (0,077±0,032 V) and the smallest was found in healthy tissues area (0,056±0,029 V) (Fig. 2).

In comparison of mean spectral slope there were no statistically significant differences found between I and III groups (mean difference 0,028±0,119, p=1,0). We found significant differences between other groups: I group vs II group (mean difference 0,322±0,119, p=0,024), II group vs III group (mean difference 0,350±0,138, p=0,037). We determined that the highest
spectral slope was in exudative ARMD area (-2.036±0.604 dB/MHz) and the lowest spectral slope was found in nonexudative ARMD group (-2.387±0.493 dB/MHz) (Fig. 3).

Fig. 2. Mean B-scan amplitude of tissues in different groups

Fig. 3. Mean spectral slope and mean spectral intercept of tissues in different groups

The results of mean spectral intercept were statistically different in comparing I and II groups (mean difference 5.871±1.309, p=0.0), also I and III groups (mean difference 3.567±1.309, p=0.022). There was no significant difference between II and III groups (mean difference 2.304±1.511, p=0.390). The highest value of spectral intercept was determined in II group (-4.266±5.542 dB) and the lowest value of spectral intercept was detected in I group (-10.137±5.756 dB) (Fig. 3)

Conclusions. Results of our study revealed that evaluation of B scan amplitude and spectral intercept enable detection of ARMD. Spectral analysis can be used as an additional diagnostic tool for ARMD and for differentiating
nonexudative ARMD from exudative ARMD. Also spectral analysis enables us to distinguish ARMD from other retinal disorders. Further investigation including more patients should be done in order to evaluate the options of spectral analysis.

References

Ultrasound Assessment of Retina in Patients with Nonexudative and Exudative ARMD
I. Sakalauskaitė1, R. Mikalauskaitė1, D. Stanislovaitytė2, B. Budienė2, J. Trumpaitis2
1Lithuanian University of Health Sciences, Medicine Academy, Lithuania
2Department of Ophthalmology, Lithuanian University of Health Sciences, Medicine Academy, Lithuania

The Aim was to compare B scan ultrasound signals backscattered from healthy tissues with signals from nonexudative (dry) and exudative (wet) ARMD areas. We compared 60 cases of healthy tissue area (I group) with 30 cases of early ARMD (II group) and 30 cases of late ARMD (III group) using B scan ultrasound. We observed that amplitude and mean spectral intercept were statistically higher in wet and dry ARMD groups than in healthy areas. Mean spectral intercept was statistically different in comparison off and II groups, also in II and III groups. Conclusions: when there are no possibilities to use more specific examination spectral analysis can be used as an additional diagnostic tool.