
Biochemical Evaluation of the Patient with Tinnitus

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The biochemical, metabolic, hormonal, and neurotransmitter influences as they relate to hearing and balance problems have just begun to be explored. The inner ear is, in fact, an internal body organ. The diagnostic and therapeutic direction for the evaluation of the neurotological patient should be oriented to confirm an etiological mechanism. This can be accomplished only if our testing modalities are used in a way that is topographically diagnostic. This approach would then logically culminate in a systematic etiological investigation.

The questions to be answered by the neurotological evaluation are:¹

1. What neurotological tests can be used for site of lesion confirmation?
2. Which biochemical, metabolic, and hormonal tests are indicated?
3. What modalities of therapy can then be efficacious?

Do you perform a biochemical, metabolic, and hormonal screen? Which tests do you use? How do you make these decisions? This is the challenge.

Mechanical energy signals that are processed and interpreted as sound originate in the environment. Other mechanical energy signals occur as a result of body movements. These mechanical energy signals must be converted to electrical energy in order to be transmitted to the appropriate areas of the brain via the eighth cranial nerve. This conversion or transduction takes place in the inner ear. The transduction process is accomplished by the chemicals within the inner ear fluids.

The process of chemical conversion of energy within the inner ear identifies the inner ear as an internal body organ and therefore relates the inner ear to other internal body organs, such as the kidney, liver,

and thyroid. The functions of sugar and fat metabolism, of hormonal control, and of the immune and stress systems are involved^{10,11} in the chemical control of inner ear biochemistry. The source of the chemicals that are involved in all of these processes is the food that each of us eats.

The processing of the chemicals that originates in our food and the transport of the chemicals to the inner ear fluids involves a three-step obstacle course. These obstacles are: the gut wall, the blood-brain barrier, and the endolymphatic sac and duct. At each step along the way, there is differential absorption that allows passage of only the necessary chemicals at the proper concentration for efficient inner ear function.

Is there then any question about proper nutrition being significant? Is it not important to supplement our diet with necessary nutrients? How much better to incorporate nutritional management than to use drugs without therapeutic effect and with many side effects.⁶⁻⁸

What then are the tests that need to be performed in order to determine the proper therapeutic regimen. After a complete history and physical examination are done, the confirmatory tests are in the following groups:²

1. Audiological evaluation
2. Vestibular function testing
3. Biochemical, immunological, and hormonal testing
4. Imaging and brain mapping tests

The tests within the audiological area that are necessary are the following:

1. Pure-tone air and bone conduction audiometry
2. Speech reception thresholds and discrimination tests
3. Tympanometry and stapedial reflex tests
4. Auditory brainstem-evoked responses to include middle and late latency function tests
5. Tinnitus matching and suppression tests

This battery of audiological tests are those that are useful for site of lesion identification. The results from this group of tests will be helpful to the physician for correlation with vestibular function testing.

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BRAIN MAPPING

Brain mapping is another adjunctive testing modality that is particularly useful in objectively confirming neurotological problems caused by metabolic and traumatic mechanisms.

Methods have been developed to analyze quantitatively the electroencephalogram (EEG) through spectral analysis, thereby, removing much of the subjective aspect of interpretation and revealing features of the background EEG that are normally difficult to extract by visual examination. By combining such methods with topographic displays of the EEG data, topographic displays of evoked potential data, and statistical comparisons of patient data with data from age-matched normal control groups, known as statistical probability mapping, a much more sensitive approach to the evaluation of brain function has been produced. This approach, which is known as brain electrical activity mapping, has proved useful in detecting abnormalities consistent with organic dysfunction in many patients presenting with symptoms suggesting an organic basis, but having otherwise normal results on conventional testing, such as routine EEGs.³

BIOCHEMICAL EVALUATION

The biochemical metabolic evaluation of the neurotological patient should include tests of the following:

1. Cholesterol
2. Triglyceride
3. Thyroid
4. Glucose tolerance response-ENG monitored
5. Blood urea nitrogen
6. Serum glutamic-oxaloacetic transaminase (SGOT)
7. Complete blood count (CBC)
8. Fluorescent treponemal antibody absorption (FTA-ABS)
9. Prolactin level in females
10. Uric acid
11. Radioallergosorbent test (RAST) immunologic studies
12. Fasting blood sugar (FBS)

The number of abnormal test results in neurotological patients have been greatest in fat metabolism, sugar metabolism, RAST studies, and FTA-ABS tests. Abnormality has been found next most commonly in the prolactin testing. Some abnormalities of liver and kidney function and an occasional abnormality in the thyroid testing have been found.

In the fat metabolism area, triglyceride abnormality has been the most common abnormal finding. Management of these abnormalities is based on phenotype, low

density lipoprotein and high density lipoprotein measurements. These are performed before a routine of treatment and dietary instructions are given to the patient.

Control of sugar metabolism abnormalities, both in the hyper- and hypoglycemic states, is accomplished by diet. A great number of patients with poor nutritional habits have been found and confirmed based on an ENG-monitored glucose tolerance curves (flat). These patients respond to a dietary routine that is similar to that prescribed for patients with hypoglycemia, that is, a diet low in noncomplex carbohydrate and with little refined sugar but high in proper proteins.

There have been both clinical and research confirmation of conventional allergy triggers being the cause of neurotological abnormalities.⁵ Inhalant allergies are by far less commonly responsible than food and chemical triggers.³ The anecdotal reports of the past have been corroborated by research documentation. Immunological causes have been responsible for the neurotological symptoms in 5 to 6 percent of my patient population. There are also many more patients with neurotological symptoms in whom immunological triggers occur in combination with other biochemical or metabolic factors.

The abnormalities found on the CBC studies have been anemias, polycythemias, and an occasional case of leukemia. Abnormalities of liver function with the SGOT test have been found to be primarily in alcoholics. Most alcoholics do not admit that they are, in fact, alcoholic when the history is taken. The relationship between kidney abnormality and inner ear abnormalities for both hearing and balance problems has been discussed in the medical literature for many years. We have found an occasional problem that fits into this category of abnormality.

The relationship between prolactin levels in females and neurological abnormalities has been described by Katsarkis. The most interesting relationship is the fact that a deficiency in tryptophan in persons who have poor dietary intake, especially females, causes an elevation of the prolactin levels and, therefore, inner ear abnormality. These patients are easily controlled with change of diet and tryptophan supplementation. Tryptophan is involved in the serotonin cycle and this may well be the neurotransmitter basis of the problem.⁹

The high levels of zinc normally found in the choroid of the eye, the inner ear, and prostate has been described by a number of investigators, particularly Shambaugh.² We have just begun to evaluate patients for zinc and calcium levels. The use of zinc supplementation is a method of treating patients in whom the levels of zinc or calcium, or both, are low and may be the cause of tinnitus, hearing loss or dizziness.

Biochemical evaluations have been extremely rewarding in the search for etiological mechanisms in the neurotological patient. They have been diagnostically

confirmatory in 45 to 50 percent of our patients. In these patients, the treatment results are gratifying when the patient follows the instructions. This method of etiological diagnosis and treatment has significantly reduced the necessity of using long-term symptomatic medication.

SUMMARY

Biochemical mechanisms are a significant factor in neurotological problems. Investigation of biochemical causes of neurotological problems are warranted and can be cost effective. Dietary, nutritional, chemical, hormonal, immunological, and stress factors are directly involved in neurotological problems and need to be evaluated and considered when one designs the treatment regimen.

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