HEARING SOLUTIONS SIG

Sun City Texas Computer Club

April 11, 2019

Your membership to the Computer Club entitles you to attend any of our Special Interest Groups. We think this is the most important one. ☺

Thank you for coming today.

YEAH !!!

Have you seen this Emblem posted outside Texas Drive exercise room?

NEXT MEETING

May 9, 2019

Members Sharing with Members

THE COGNITIVE AND BEHAVIORAL CONSEQUENCES OF HEARING LOSS

by

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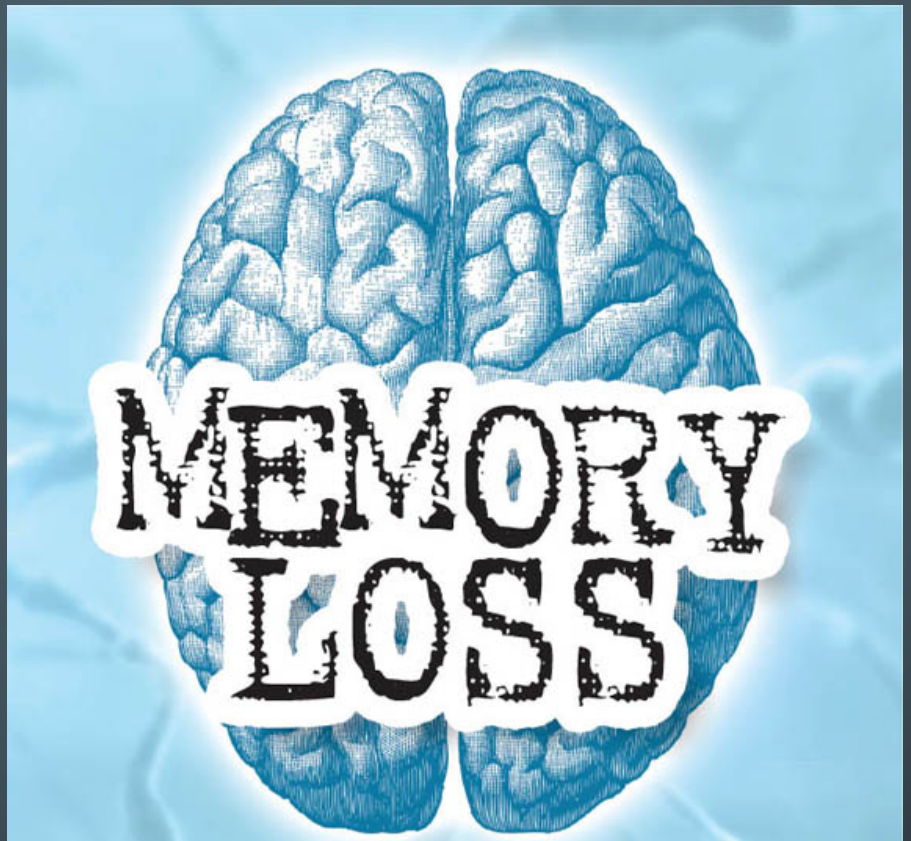
"My memory really sucks Mildred, so I changed my password to "incorrect." That way when I log in with the wrong password, the computer will tell me... "Your password is incorrect"



MEMORY LOSS

Everything You Want To Know But Forget To Ask

RONALD DEVERE
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THE GLASS IS HALF FULL, NOT HALF EMPTY

FIVE IMPORTANT BRAIN FUNCTIONS THAT MAKE UP OUR COGNITIVE ABILITIES

- MEMORY
- EXECUTIVE (REASON, INSIGHT, PLANNING)
- PERSONALITY
- SPEECH AND LANGUAGE
- VISUAL PERCEPTION

VERY IMPORTANT DEFINITIONS

- MILD COGNITIVE IMPAIRMENT (MCI)

  One or more areas of cognitive disturbance that does not significantly impair activities of daily living.

- DEMENTIA

  The presence of two or more areas of cognitive impairment that impairs activities of daily living.

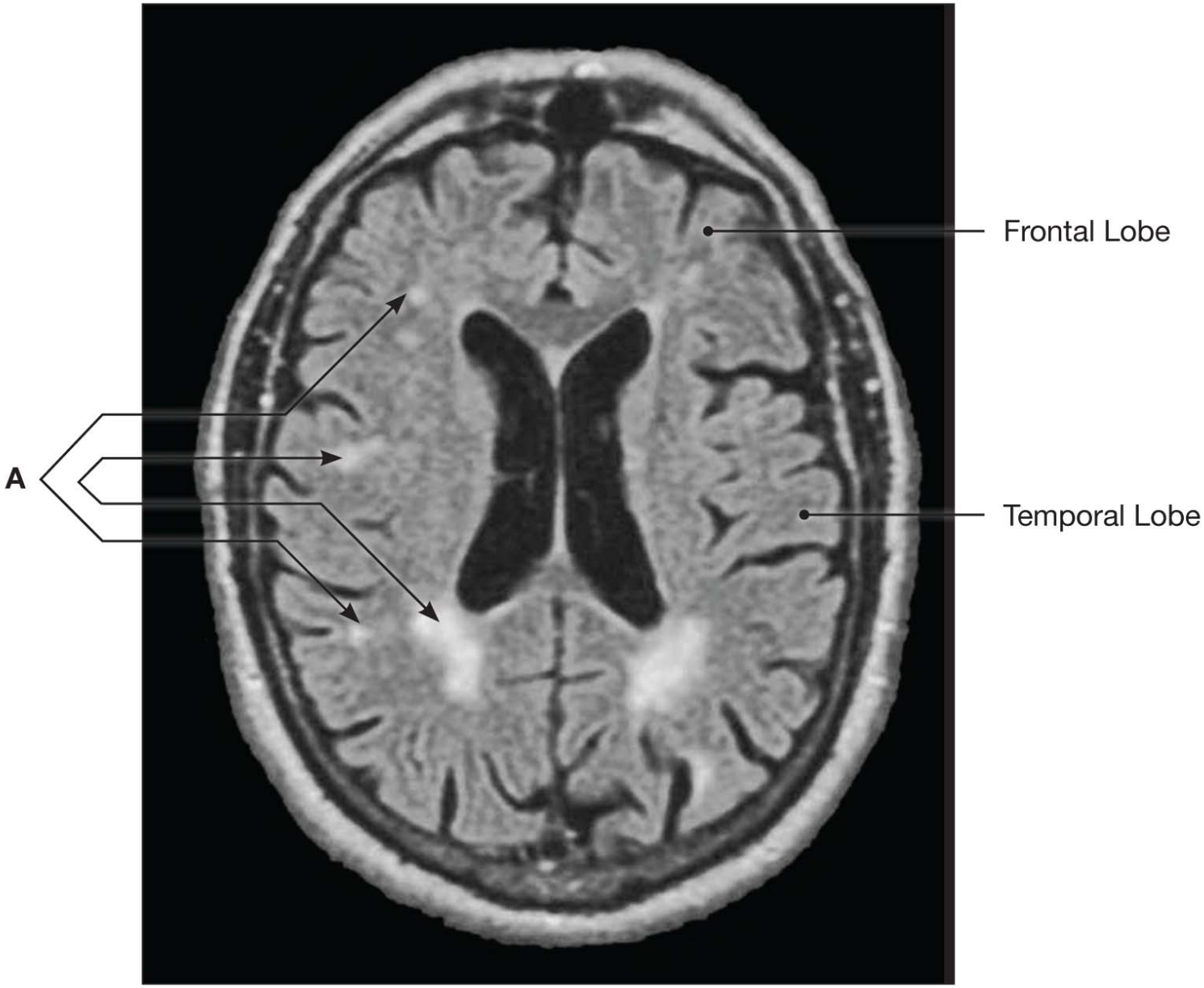

Fig 6.25 MRI of the brain showing multiple white areas (A) that suggest small strokes

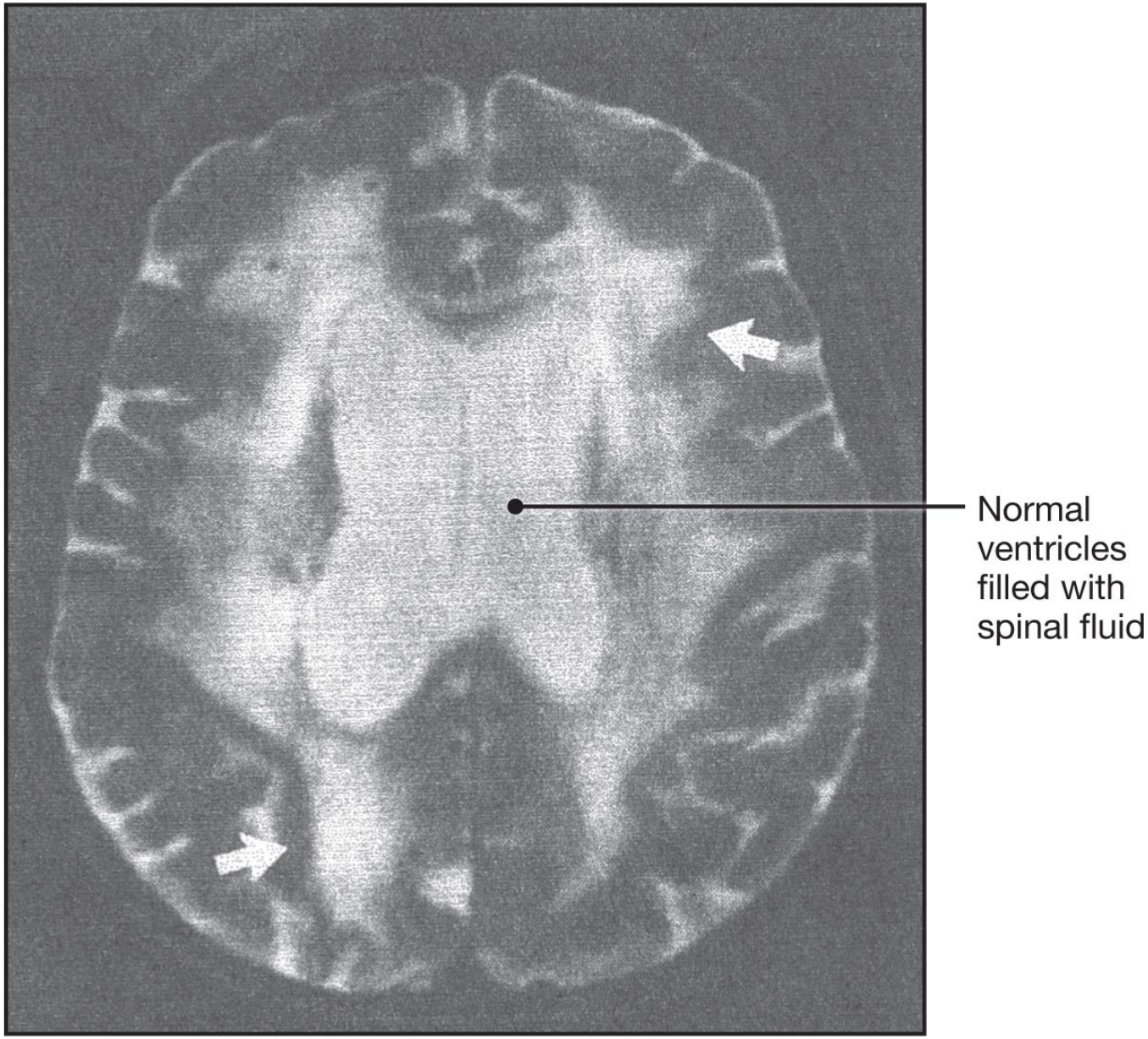

Fig 6.7 MRI of the brain showing marked stroke changes (white arrows) around the normal ventricles (spinal fluid space)

HEARING HAS 2 MAJOR DOMAINS

1. PERIPHERAL HEARING. transmission of sound through the auditory periphery. Includes outer and middle ear and sound encoding by the cochlea. MAIN FUNCTION: SOUND DETECTION

2. CENTRAL AUDITORY PROCESSING (CAP). temporal, parietal, frontal, brainstem and midbrain circuits. MAIN FUNCTION: AUDITORY PERCEPTION & UNDERSTANDING

- Auditory objects in our daily life are: Speech, Voices, Music, Environmental noises.
- These require separation from auditory background and organized with coherent representation.
- Processing of sound recognition by CAP includes encoding of pitch, rythm and timbre leading to meaning of this sound information to sound recognition.

- Hearing loss>20db which affects pure tone detection, affects 40% >65yrs and 80%>85yrs(1)
- Age related hearing loss(presbycusis) most commonly results from Cochlea Dysfunction
- Age related alteration in CAP has been underrecognized(3)
- Hearing loss >25db has an effect on cognitive decline equal to 7yrs of aging. (Baltimore longitudinal aging study(2)

- Hearing loss and its effect on auditory processing, speech communication and psychosocial well being has been studied for many years (5,6)

- Hearing loss and its negative effect on cognition has only been detailed studied in the last 3 yrs.(7)

BRAIN CHANGES OBSERVED WITH PRESBYCUSIS

- Test used are: a. MRI Voxel based morphmetry which measures thickening, concentration and volume of gray matter
- Diffusion Tensor Imaging: measures integrity of white matter by diffusion of water molecules.
- Poor hearing is associated with reduced gray matter volume in the auditory cortices when age related structural brain changes were controlled(20,24)

BRAIN CHANGES OBSERVED WITH PRESBYCUSIS (CNT'D)

- White matter integrity going in and out of auditory cortex (via inferior colliculus) has been recognized(28)
- These pathological changes noted with hearing loss does not appear due to aging alone. Hearing loss leads to sensory deprivation, information degridation and changes in brain anatomy.

BRAIN CHANGES OBSERVED WITH AGE RELATED HEARING LOSS (CNT'D)

- Prefrontal cortex gray matter, superficial temporal cortex volume and thickness is reduced in patients with poor ability to perceive speech in noisy environments(25)
- Hearing loss >70db showed reduced gray matter volume in bilateral anterior cingulate, medial frontal gyrus and superficial temporal cortex(26). NOTE: many studies were not longitudinal. Not sure if changes occurred before or after hearing loss.

BRAIN CHANGES IN PRESBYCUSIS

- One study looked at FMRI on effects of hearing loss on emotional processing using normal hearing age matched controls(26)
- Participants rated digital sounds as pleasant, unpleasant or neutral. The normal Hearing group used the limbic auditory regions compared to hearing loss group suggesting functional alteration beyond the auditory cortex.

BRAIN CHANGES IN PRESBYCUSIS

- A FMRI study (23) showed that during sentence comprehension, difference in hearing predicted degree of neural recruitment in Bilateral superior temp gyrus, thalamus and brainstem. Those with poor hearing showed less language driven brain activity even when age was controlled.
- Using AEP's in normal hearing and those with hearing loss. The latter showed reduced activation in temp cortex vs increased activity

BRAIN CHANGES IN PRESBYCUSIS

- In frontal cortex suggesting changes in allocation of cortical resources.
- NOTE: ERP'S measure electrical brain activity that can correlate with a cognitive process, It is more objective and measures neural transmission time and strength of response.
- Using VEP's in these studies showed that the amplitudes were larger and latency decreased in those with hearing loss (30)

BRAIN CHANGES IN PRESBYCUSIS

- These findings showed increased activation of auditory processing with visual stimulation suggesting visual cross modal reorganization (30).
- Visual stimulation is trying to compensate with central processes in the brain with high frequency hearing loss.

- Is cognitive impairment in MCI and Dementia caused or worsened by hearing loss or does cognitive impairment cause hearing loss? Neither one has been proven.
- Generally agreed that the structural and physiologic brain changes are not due to aging alone.

POSSIBLE UNDERLYING MECHANISMS OF AN ASSOCIATION OF HEARING LOSS WITH COGNITIVE IMPAIRMENT

- 1. Overdiagnosis:

Majority of older adults do not seek Dx and treatment for hearing loss. Many don't use prescribed hearing aids and often pretend they understand verbal comments. This can masquerade as cognitive impairment (testing, ADL's)

- Study in 2012 (34) looked at hearing loss on the MMSE score in 125 different age adults using 5 level of auditory impairment. Those with mild to moderate severe hearing loss, 16% were misdiagnosed as probable dementia. Higher percentage was noted in worse hearing loss.
- Be sure to ask caregivers, patient etc. about hearing loss. Refer to ENT if hearing loss noted before detailed cognitive assessment.

- 2. Widespread Neurodegeneration

Matching of incoming sounds during life are likely stored in a neural template. Disruption of this template from Neurodegenerative disorders may cause impaired sound perception and abnormal behavior to sounds.

REMEMBER: Impaired sound perception not due to peripheral of subcortical hearing loss called Auditory Agnosia or word deafness, a cortical disorder.

- 3. Sensory Degradation/Deprivation

Peripheral hearing loss affects audibility and clarity of sounds. Info reaching the cortex is degraded. This cause structural changes in the CAP and cognitive systems. One study (2) found neuroimaging evidence of Brain Atrophy and decreased volume in temporal lobe compared to normal hearing controls in a 6 yr. study.

- A study(41) examined behavior changes in MCI or Dementia after short term use of sound amplification with hearing aids.
- This led to improved compliance in use of hearing aids and decreased behavior problems after 2 month use. (better results with early hearing loss.

4. Cognitive Resource Allocation and Depletion

2011 study (23) showed when incoming auditory signals were degraded from hearing loss fewer resources were available for cognitive processing (eg. Working memory, long term recall). Decreased gray matter density was shown in primary auditory system suggesting a reorganization of the brain processing system.

- In another study (42), 24 individuals mean age 69 with hearing loss had similar cognitive spare capacity as normal hearing controls when listening conditions were optimal suggesting that cog function may be decreased in older people with hearing loss due to reallocation of valuable resources in an effort to process degraded auditory signals

- 5. Social Isolation and Depression

Individuals with decreased hearing withdraw socially due to high level of background noise and increased effort to communicate.

This increases communicating effort leading to frustration and depression.

Social isolation is a recognized risk factor for cognitive decline. (43, 44)

HISTORY AND EVALUATION FOR HEARING LOSS

- All patients with a primary cognitive complaint or noted in ROS, the neurologist should get a detailed HX of any hearing loss from the patient, caregivers, friends who are at the exam.
- QUESTIONS TO ASK: a. when did hearing decline and when did cog change occur? b.is there a tendency to increase the TV volume and ask people to speak louder? c.Is there trouble following conversation in noise?

- d. were you exposed to a noisy environment in your current or previous work?
- SPECIFIC QUESTIONS TO SUGGEST A CENTRAL CEREBRAL DISORDER.

a. Do you have trouble locating sounds?(alarms, mobile phone,)

b. Trouble understanding speech; other sounds recognized.

c. trouble understand tones of voice (angry, happy)

HISTORY AND EVALUATION FOR HEARING LOSS

- If any of these questions are positive, patient should be referred to ENT (wax in ears, ear drum and cochlear concerns). This will usually lead to audiology referral for quantitative testing.
- Audiologists will do pure tone audiometry, AEP's, which assess cochlear and ascending auditory pathways.
- Hearing thresholds>25db begins to impair verbal speech communication in noise.

- This more closely reflects the real world hearing impairment than pure tone audiometry.
- Neuropsychological testing that measures attention and focus offers a good auditory evaluation for hearing impairment especially for verbal and visual categories.

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- 1. AMPLIFICATION

Hearing aids have been available for many years but little information on its benefits in cognitive decline.

A 25yr study (3) evaluated 3670 elderly folks with self reported hearing loss, use of hearing aids and cog decline(mean age 76-81). 4% had major hearing loss, 31% moderate, 67% no hearing loss.(MMSE & HX were used).

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- Hearing loss with no aids declined more rapid.

(1.5 points).Those with hearing aids and no hearing problems were same on MMSE.

Other studies (4, 5) have shown reduced rates of cognitive decline with hearing aids and cochlear implants.

Self reported hearing loss is independently associated with accelerated cog decline when depression, social network and psychotropic meds were used.

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- This suggests that hearing aids and cochlear implants may improve mood, social interaction which can lead to slower cognitive decline.
- 2. AUDITORY TRAINING

Understanding speech in background noise is a major problem. Auditory training does as follows:1 word based to focus on meaning of words. 2. computer based. 3. multiple speakers

4. Conducted in noisy background

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- 5. Both auditory and written feedback used
- 6. 2 days/wk. for 7.5 wks. or 3days/wk. for 5 weeks.

55 subjects in 3 groups: 16-2x/wk., 19-3x/wk.

20-no training. age range (61-79). All had mod to severe sensory neural hearing loss. Training 2-3 times per week showed significant improvement in trained speech recognition in noise. Cog function has not been studied.

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- 3. COGNITIVE BEHAVIORAL THERAPY REMEMBER Hearing loss is associated with mental stress, anxiety, social isolation all impairing QOL.
- A study(1) of 80 veterans over 65 with gradual hearing loss showed this and social isolation had a stronger correlation with subjective rather than objective measures.

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- A study (2) of 2461 persons studied 5 times over 20 years found that those with moderate hearing loss were 2x likely to be depressed.
- Another study(7) 2 months looked at 24 elderly hearing impaired (average 38db) received behavior therapy or were controls. All used hearing aids. Behavioral therapy helped the treated group cope much better with hearing loss evident from video interviews and self reports.

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- Another study (8) included 15 cases (med age 50) with hearing loss from 7.5 to 82db. Received weekly 2 hr. cog and behavioral therapy for 8 weeks. Homework given and reviewed and each was carefully supervised. The control group did not receive this therapy.

The depression and anxiety scores were very much reduced in the treated group and increased in the untreated group.

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- Another study (9) trained working memory in hearing aid users. No pre or post training improvements were noted for simple tasks(digit span or single attention tasks).

HOWEVER, complex tasks that measured executive processing showed significant post training improvement in divided attention and working memory. Outcome measures need to be more complex and challenging to be helped by auditory cognitive training.

TREATMENT OPTIONS FOR HEARING IMPAIRMENT

- Auditory perceptual training programs combining auditory training with increased memory demands have shown general improvement in non trained tests of memory , attention and speed of processing in older adults in addition to speech perception in noise.

CONCLUSIONS

- A. Hearing loss is associated with cognitive impairment which correlates with severity of hearing loss.
- B. The exact mechanism is unclear but appears to involve multiple mechanisms
- C. In most cases hearing loss is treatable and is NON PHARMACOLOGICAL.

CONCLUSIONS CNT'D

- D. Neurologists must take a hearing loss hx from the patient, caregiver, friends etc. especially in those patients who present with cognitive impairment or in any patient with a positive ROS for hearing decline.
- E. Referral of all novice hearing impaired individuals to ENT physicians and encourage those not using their hearing aids to use them daily.

CONCLUSIONS CNT'D

- F. Be sure to follow up the auditory workup and be sure the patient is using his prescribed hearing aids.

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http://practicalneurology.com/pdfs/pn1117_Dementia.pdf