DISCUSSION

An accurate diagnosis of apraxia of speech is very important which depends on accurate evaluation of the patient during various speech tasks such as automatic speech, spontaneous speech and oral reading. [4]

Apraxia Battery for Adults II (ABA II) is the standardized test that is widely used as a formal measure of apraxia characteristics in adult speech. It was designed to provide clinicians with a measure to assess apraxia of speech. It can give measure about the severity of the disorder, and it can be used to direct therapeutic approaches in the treatment of apraxia. [5]

Diagnostic aim of apraxia testing is met in ABA II by comprehensively sampling all variables in speech performance of apraxic patients including articulatory inconsistency on repeated productions of the same utterance, difficulty initiating utterance, inconsistent and variable articulatory movements, a general slowed rate of speech with resulting prolongations of transitions, pauses between syllables and words.

In this study ABA II was translated and modified to be used as an assessment tool for Egyptian Apraxic patients. The study was conducted on two groups: fifty six adult patients with expressive aphasia and /or dysarthria with ages ranged from18 to 76 years and one hundred normal adult subjects as a control group. Participants with normal speech and language were evaluated by the proposed protocol of apraxia assessment to yield cutoff scores and to test the validity of the test and its ability to differentiate between those with normal speech and apraxic patients.

The patients were collected from outpatient clinic of the Phoniatrics Unit in the Main University Hospital, Alexandria University from April 2013 to October 2014. Control sample was chosen mainly from the relatives of the patients coming to the clinic to ensure inclusion of subjects from the same cultural background and educational level.

Pilot study was done to check the suitability and clarity of the materials for Arabic speaking subjects and the pattern of test presentation.

Clinical diagnosis was used to identify apraxic patients out of dysarthric and aphasic group. It was found that 37.5 % of the patient group was apraxic depending on the presence of various apraxic features.

The age range of the sample was between 18 to 76 years, it was divided into two age groups: from 18 to 45 years and above 46 years. More than half of the apraxic patient group was above 45 years as AOS with associated disorders aphasia and dysarthria tend to occur at older age which was agreed by the study done by Engelter et al (2006) [78] . In their study; incidence and determinants of aphasia attributable to ischemic stroke was assessed which revealed that aphasic patients were older than nonaphasic.

As regard **gender distribution**, nearly fifty seven percent of apraxic patients were males. This was due to the fact that stroke is more common among men than women and it might be due to higher referral of males to language and speech therapy (for social and professional reasons).

According to educational level, patients were divided into three groups: Illiterate, Middle education: from primary to secondary education, High education group: subjects who had university level of education and above. The high percentage of middle education and illiterate patients due to the fact that Alexandria main university hospital provide health services to people of Alexandria and the surrounding rural areas where citizens tend to be of low educational levels.

Diagnosis of the patient's condition varied between expressive aphasia, spastic dysarthria and UMN dysarthria in association with AOS. It was found that AOS occurred most commonly in association with expressive aphasia that can be explained as these two disorders share the same site of lesion (Broca's area).

As to **the cause of the neurological insult** that leads to AOS, nonhemorragic brain infarction is the most common cause. Other causes included brain trauma and infection. This finding was agreed by Duffy (2005) who stated that brain infarction is the most frequent cause leading to AOS. [4]

Site of the lesion that can lead to AOS varied among different areas of the brain. Left inferior frontal gyrus (Broca's area) was the most common site which constituted 42.9% of apraxic patients. This can explain the frequent association between AOS and expressive aphasia. Other sites were affected in apraxic patients as left temproparietal region (19%), left parietal lobe (14%) and left frontoparietal (insula) with left temproparietal (14%). This finding was agreed by Hillis et al (2004) and Ogar et al (2006). They stated that the previous mentioned brain areas are the sites of lesion which can cause AOS. [30, 31]

Clinical features of AOS varied among apraxic patients. Some speech features were found in more than eighty five percent of apraxic patients which included:

- Inconsistent articulatory errors.
- Visible /audible searching.
- Effortful trial and error groping with attempts at self correction.
- Abnormal prosodic features (including equalized and difficult varying stress, restricted or altered pitch, durational and loudness contour and slow rate).
- Awareness of errors and inability to correct them.
- Errors which increase as phonemic sequence increases.
- Marked difficulty initiating speech.
- Fewer errors with automatic speech than volitional speech.

Other speech features were less frequent as phonemic transposition errors, perseverative errors, voicing errors.

All the patients were evaluated by various **psychometric tests** (Stanford Binet and TONI) to evaluate the cognitive abilities of these patients. On assessment using TONI, 76.1 % of apraxic patients had non verbal performance ranged between average to slow learner degree. While the scores of apraxic patients on verbal IQ test showed that no one had average or below average verbal IQ. 76.2 % of these patients had verbal IQ ranged from mild to severe degree and the rest of the patients were non testable. These poor verbal IQ scores reflect the impact of the existing speech disorder.

As regard the results of **Taylor test of anxiety**, it was found that 52.4 % of apraxic patients had no anxiety while 47.6 % showed variable degree of anxiety (50 % of which had severe anxiety). It could not be determined if anxiety caused by AOS alone or by other associated disorders as dysarthria and aphasia.

As to the results of MDVP, nasometer, aerodynamics and laryngoscopic finding, it was found that there was significant difference between apraxic and control group for jitter percent, shimmer percent and mean flow rate values. This result may be due to associated dysarthria that can affect all speech components. AOS doesn't affect all speech components as phonation and resonance and it doesn't cause muscular weakness in contrast to dysarthria. This is supported by a study done by Odell et al (2001) which stated that AOS showed no effect on voice and resonance. [79] Patients with isolated AOS are needed to further study the effect of AOS on various speech components.

As to **spectral analysis**, there was significant difference between apraxic patients and control group for vowel duration, syllable duration and sentence duration which were prolonged. This stands in line with the majority of apraxia studies as Varley et al (1999), Ballard et al (2000). [13, 37] They found that apraxic patients had increased vowel, syllable and sentence duration. This can be explained as patients with AOS tend to have slow rate with repeated trials and error groping.

Test reliability was tested using internal consistency by using reliability coefficient alpha (Cronbach's alpha) which increases as the inter correlations among test items increase. The high values of alpha in all subtest items which ranged from 0.746 – 0.937 denote significant inter correlation between test items. These results were similar to the results of the original ABA II, where coefficient alpha ranged from 0.83- 0.97.

Test retest reliability was not examined in this study and in the original test too. ABA is a measure of apraxia and is designed for individuals who experienced CVS, traumatic brain injuries and other neurological insults. So persons receiving treatment for these conditions would show varying amounts of improvement over time and would produce low test retest correlation coefficients.

Validity of the test was proven by: content validity, group differentiation and concurrent validity.

Content validity is the adequacy with which the test items adequately and representatively sample the content area to be measured. Expert judgment is the primary method used to determine whether a test has content validity. Content validity is usually determined by a panel of experts who examine the relationship between test objectives and test items, or by knowledge of the normal practices used. Experts (5 phoniatricians) examined the content validity relying on the concept tested by each subtest and its aim. They checked that the test included all relevant and important items and excluded irrelevant ones. The test was considered valid when judges indicated high satisfaction as regard test questions and pictures.

Concurrent validity: Correlation matrix between different items of the test was performed and there was significant correlation between the test items. Correlation between some subtests is negative and some are positive. In all cases there was significant correlation. For example: Subtest 1 (Diadochokinetic rate) is negatively correlated with

subtest 4 (utterance time for Polysyllabic words.). The score for subtest 1 is calculated by counting the number of times an individual can say a syllable in a given time period; high scores are desirable. The score for subtest 4 is calculated by timing the amount of time it takes an individual to say a multisyllabic word; low scores are desirable. Therefore, it is expected that individuals obtaining high scores on subtest 1 would obtain low scores on subtest 4. The strong negative correlation shows that this is the case. While in subtest 5 (Repeated trials) the score is calculated by subtracting the number of words with errors from the total number of words and high score is desirable. So, it is expected that individuals obtaining high scores on subtest 1 would obtain high scores on subtest 5. The strong positive correlation shows that this is the case.

Group differentiation is the most general type of evidence which involves the ability of the test results to discriminate between groups which are known to be different in a theoretically appropriate manner. Comparison of the mean and standard deviation of the control, aphasic, dysarthric and apraxic groups showed that apraxic scores significantly differ from the normal, aphasic and dysarthric group on all test items so ABA can discriminate between these groups. Apraxic patients had lower scores in items like diadochokinetic rate and repeated trials. While they got higher scores in items like increasing word length part A and B, utterance time for polysyllabic words, inventory of articulation characteristics of apraxia which can differ according to the nature of the test item and the way of scoring system. In subtest 1(Diadochokinetic rate) the score is calculated by counting the number of times an individual can say a syllable in a given time period; high scores are expected in normal individuals. In subtest 5 (Repeated trials) the score is calculated by subtracting the number of words with errors from the total number of words and high score is expected in normal individuals. Full score is given in subtest 3 (limb and oral apraxia) when the examinee gives complete accurate gesture; high scores are also expected. Apraxic patients showed low scores in these items. In subtest 2 (Increased word length A, B) deterioration in performance score when saying a list of words is calculated; lower scores are expected in normal individuals. The score for subtest 4 (utterance time for Polysyllabic words) is calculated by timing the amount of time it takes an individual to say a multisyllabic word; low scores are also expected. In subtest 6 (Inventory of articulation characteristics of apraxia) the score is calculated according to the presence of apraxic speech behaviors; higher scores is highly indicative of AOS. Apraxic patients showed higher scores in these previous items.

Comparison between original test scores and Egyptian sample scores revealed that statistically insignificant differences between scores of both samples in all test items. This may add to test validity as it indicates consistency of the test after translation and adaptation. Comparison between four groups (normal, apraxia, aphasia and dysarthria) in both the original test and Egyptian samples was done. Performance of these groups on different test items was compared with no significant difference.

As regard Sensitivity and specificity of the test; the modified ABA was highly sensitive and specific. Sensitivity (also called the true positive rate) measures the proportion of actual positives which are correctly identified as such (e.g., the percentage of sick people who are correctly identified as having the condition). Specificity (sometimes called the true negative rate) measures the proportion of negatives which are correctly identified as such (e.g., the percentage of healthy people who are correctly identified as not

having the condition). Sensitivity and specificity of the test were high ranged from 70.4 % to 100 % for cutoff scores of all test items.

The (ROC) curves with the areas under the curves (AUC) and their statistical significance were used as an indicator for scale and subscale performances. Statistically significant AUCs denoted performances better than chance (AUC=0.50) and the greater the AUC the better was the performance with a maximum AUC of 1.00 denoting a gold standard like performance.

Identification of the cutoff values for diagnosis was applied just for statistically significant AUCs where the value that maximized both sensitivity and specificity of the scale was chosen. Values above or equal to the identified cutoff values denote being a case. AUC proved to be large for all test items denoting high sensitivity and specificity.

In comparison of **the cutoff values of the original test and Egyptian sample**, they were the same values for subtest 4 and 6 (Utterance time for polysyllabic words and Inventory of articulation characteristics of apraxia) the rest of the cutoff values were more or less very near to the original test. This may add to test validity as it indicates consistency of the test after translation and adaptation.

SUMMARY

Apraxia of speech is a motor speech disorder resulting from the impairment of the capacity to program sensorimotor commands for positioning and movements of muscles for the volitional production of speech. It can occur without significant weakness or neuromuscular slowness, and in the absence of disturbances of thought or language.

Diagnosis of AOS depends on tasks placing demands on the volitional sequencing of a variety of sounds and syllables which are most likely to elicit the salient and distinguishing features of AOS. Conversational and narrative speech and reading can be used for this purpose, particularly if language and reading skills are good and the patient can give more than brief and unelaborated conversational or narrative responses.

The aim of the study is to develop a comprehensive, valid and reliable tool for evaluation of patients with acquired apraxia of speech. This was done through translation and use of the test of Apraxia Battery for Adults in evaluation of these patients.

Apraxia Battery for Adults (ABA) was designed to verify the presence of apraxia in adult patients. It consists of six subtests. The administration time of ABA II is about 20 minutes. Some patients may respond slowly and require considerably more than 20 minutes completing the battery

The test was translated to Arabic language and modified to suit Egyptian culture. Then it was applied on 156 adults divided into fifty six adult patients with expressive aphasia and /or dysarthria and one hundred healthy adult subjects. The patients group included adults of both sexes aged 18 years and above with expressive aphasia and or dysarthria and history of speech and or language affection starting after incidence of neurological insult. Pilot study was conducted to check test materials and if it is suitable to Egyptian patients.

Each subject was subjected to the apraxia evaluation protocol which consisted of three procedures to detect the presence of apraxia of speech, aphasia and dysarthria and to determine the type of dysarthria and dysphasia if present. This evaluation included complete history taking, Complete clinical examination with application of certain tests like articulation test, aphasia test, Stanford Binet and Taylor test of anxiety beside ABA II application. Patients were also evaluated by CSL, MDVP, nasometer and aerodynamic measures which proven to be not affected by AOS.

Reliability of the test was proven by internal consistency reliability using reliability coefficient alpha (Cronbach's alpha).Validity was proven using content validity, concurrent validity and group differentiation. All methods indicated that the test is reliable and valid as a test for apraxia of speech evaluation. The modified ABA was proved to be highly sensitive and specific.

CONCLUSION

The Arabic version of Apraxia Battery for Adult II is a valid and reliable test for the use in evaluation of Arabic speaking apraxic patients.

The results were highly significant and were capable of discriminating between apraxic patients and patients with other speech and or language disorders.