

Original Research Article

Brain stems Evoked Response Audiometry Profile in Chronic Renal Failure

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Abstract: Renal failure result in accumulation of nitrogenous waste in the body it is reversible in acute renal failure and irreversible deterioration of renal function leading to progressive destruction of nephrons in chronic renal failure (CRF). There is uremia, hyponatremia, hypertension and fluid retention in CRF causes direct and indirect effect on the inner ear including audio- vestibular apparatus. The association of hereditary nephritis and deafness was established by examination of hearing with controlled audiometer. Now with the introduction of auditory evoked potential recordings, the new era in diagnosis of nervous pathway and its disorder started. Few workers have studied the effect of hearing loss in chronic renal failure patients on BERA with conflicting results therefore the present study was under taken to assess the effect of chronic renal failure on hearing loss. Total sixty subjects were randomly taken age & sex wise divided into two groups. Group I consisted of thirty normal individuals, with normal hearing as control group. Group II consisted of thirty subjects with chronic renal failure, the specific tests for hearing assessment were performed i.e. PTA, SISI & BERA. The mean hearing threshold for PTA was 18.92 db in Group I whereas the mean threshold for PTA in Group II CRF was 28.60 db sensory neural hearing loss. The recruitment was observed in 21 cases i.e. 70%. On BERA test there was statistically significant delay in absolute latencies of all waves I through V. whereas absolute latencies have normal course. As study of B.E.R.A. for determination of hearing loss in CRF patients was minimum but its use provides a new era in the diagnosis of auditory pathway therefore statistically significant prolongation of absolute latencies of wave I, III&V in chronic renal failure suggests cochlear involvement.

Keywords: Pure tone Audiometry, chronic renal failure, B.E.R.A

INTRODUCTION

Renal failure is defined as deterioration in renal function, sufficient to result in accumulation of nitrogenous waste in the body. It may be rapid and usually reversible in acute renal failure, while it may be slow, more sustained & irreversible deterioration of renal function leading to progressive destruction of nephrons in chronic renal failure (CRF). Several changes do occurs secondary to renal failure. There is usually uremia fluid retention, hyponatremia and hypertension having direct and indirect effect on the inner ear. It not only causes disturbances of fluid and electrolytes balance but also affects almost all the vital organs of the body including audio-vestibular apparatus. Apparent familial inheritance of renal disease was first reported in 1875 [1]. The hereditary nephritis was than reported in 1923 [2]. For the first time a clear cut description of hereditary nephritis with sensorineural

deafness was given in 1927 [3] now called as Alport's syndrome.

The association of hereditary nephritis and deafness was established by examination of hearing with controlled audiometry in (1970) [4]. The structural similarity between glomerulus and stria vascularis were studied in 1973 [5] that kidney and cochlea were both concerned with electrolyte transport. The relationship between cochlea and kidney by reporting anatomical similarity and its shared antigenicity between them were strengthened in 1973 [6]. Quick *et al.*; in 1976 [7], they detected hearing loss audio logically in 107 cases out of (602) patients. They described that hearing loss was not due to the single factor but simultaneously enumerated common renal diseases which causes hearing loss due to glomerulonephritis, chronic pyelonephritis, Alport's syndrome, diabetic neuropathy, polycystic kidney, nephritic syndrome.

The membranous cochlea or scale media is triangular in section, consisting of organ of Corti, which is a sensory organ of hearing which has numerous hair cells. In renal failure various changes do occur in outer hair cells and spiral ganglia as observed in different temporal bone specimens without any abnormality in eighth nerve. In renal failure, changes do occur in salt and water metabolism as a result of which audio-vestibular changes take place. The advancements in the management of renal failure patients by dialysis and renal transplant there is a dramatic increase in the life expectancy and survival which leads to more and more problems in the other systems like audio-vestibular function this was observed in 1976 [8]. The role of electrolytes in hearing loss is still controversial [9-11]. In addition to that no definite relationship was established between severity of renal failure and hearing loss [12-14].

Now with the introduction of auditory evoked potential recordings, the new era in diagnosis of nervous pathway and its disorder started [15]. Since then the brainstem evoked response audiometry has been utilised to find out the association of nervous system in various conditions like hypothyroidism, diabetes, sudden deafness & chronic renal failure [16-19].

MATERIAL AND METHODS

The proposed study was conducted in the department of ENT & Medicine I.G. medical college, Shimla for the first time. Total sixty subjects were randomly taken and divided into two groups. Group I consisted of thirty normal individuals, age & sex matched with normal hearing as a control group. Whereas Group II consisted of thirty subjects with chronic renal failure, randomly picked up from both sexes & age matched. Detailed history was taken, complete general physical and otolaryngological examination was carried out to exclude vertigo, ear discharge, trauma, otitis media & ear surgery. Subjects with history suggestive of diabetes, Hypertension, ischemic heart disease, tuberculosis & cerebrovascular disorders were excluded from this study by doing relevant investigations. Subjects with history of heavy smoking, anticonvulsants drugs, methyl dopa, nitrofurantoin, reserpine & other ototoxic drugs which effect central nervous system functions were also excluded from this study. The routine investigations like complete urine analysis, blood sugar, blood urea, serum creatinine, serum electrolytes, Haemoglobin & ultra sonogram were done to diagnose the patients of chronic renal failure.

Specific tests for hearing assessment were done i.e.

1. Pure tone audiometry was done in all the 50 subjects to know the subjective pure tone audiometry thresholds on M.K.500 arphi audiometer in partially sound attenuated room.
2. Special tests of hearing i.e. short increment sensitivity index test were performed to differentiate a hearing pathology of cochlear & retro cochlear types.
3. Brain stem evoked response audiometry was conducted on both the groups on Nicolet compact IV 2000 system. The subjects were explained the procedure and test was conducted in supine position with 30° flexion of neck with pillow to make the patient comfortable. Skin over forehead, mastoid & vertex area was prepared by cleaning it with spirit and then rubbing the sand gel gently. Silver disc electrodes filled with electro gel were attached at specific sites with help of cellophane tape. The invertive electrodes were placed at vertex & non invertive electrodes were placed on mastoid process of both sides.

Headphone was adjusted on the patient's ear. Stimulus in the form of rarefaction clicks of total 2000 clicks @ 11.4 MSc at 20 db SL were given. And masking was done on the non test ear. The response was amplified, averaged and displayed on a video display unit. The averaged response was graphically recorded using a built in X-Y plotter. Two such responses were tested separately. Absolute wave latencies of wave i, iii and v were noted and the interpeak latencies of i-iii, iii-v and i-v were also calculated. The wave morphology was studied in detailed. The results were statistically analysed by student's t-value. The mean values and standard deviations for latencies of the different waves and for the interpeak latency were calculated for each age & sex groups of control and patients.

OBSERVATION

In this study 30 normal individuals as a control group-I out of which 15 were males and 15 were females. Their mean age was 52.33 yrs. The Group-II consisted of 30 cases of chronic renal failures patients out of which 17 were males & 13 were females. Their mean age was 45.90 yrs. The cases were divided into two age groups i.e. 30 to 45 years and 46 to 60 years. The mean hearing threshold for pure tone audiometry was 18.92 db in group-I which was within normal hearing threshold range. Whereas the mean hearing threshold for pure tone audiometry in group II was 28.60 db which was more than the normal hearing threshold range & the recruitment test were observed in

21 cases out of 30 cases i.e. 70% shown in table-I & table-II.

The mean hearing threshold for pure tone audiometry in group I males was 18.86 db and in females was 18.92 db which was within normal hearing range. whereas the mean hearing threshold for pure tone audiometry in group II male was 28.94 db and females was 28.15 db which is more than the normal hearing threshold range.(histogram no-1). The age & sex wise correlation between group I and Group II was made but no positive statistically significant results were found. With p – value $p > 0.005$

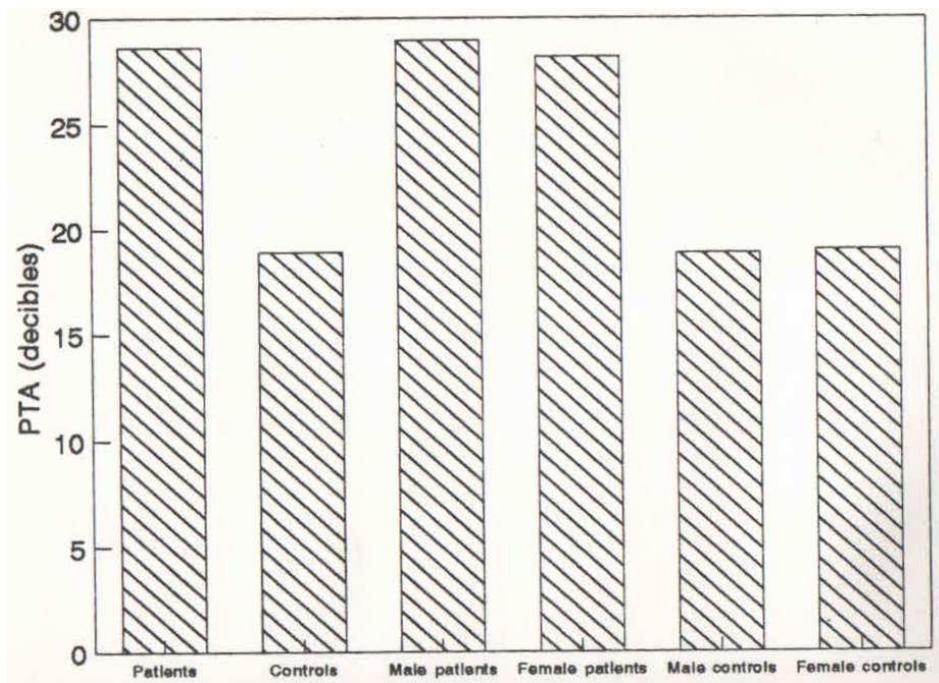
The mean absolute latencies of different waves in group I were
 Wave I 1.45+/- 0.20msec
 Wave III 2.96+/- 0.19msec
 Wave V 4.31+/- 0.22msec

The mean absolute latencies of different waves in group II were
 Wave I 1.937+/- 0.169msec
 Wave III 3.503+/- 0.397msec
 Wave V 4.910+/- 0.282msec

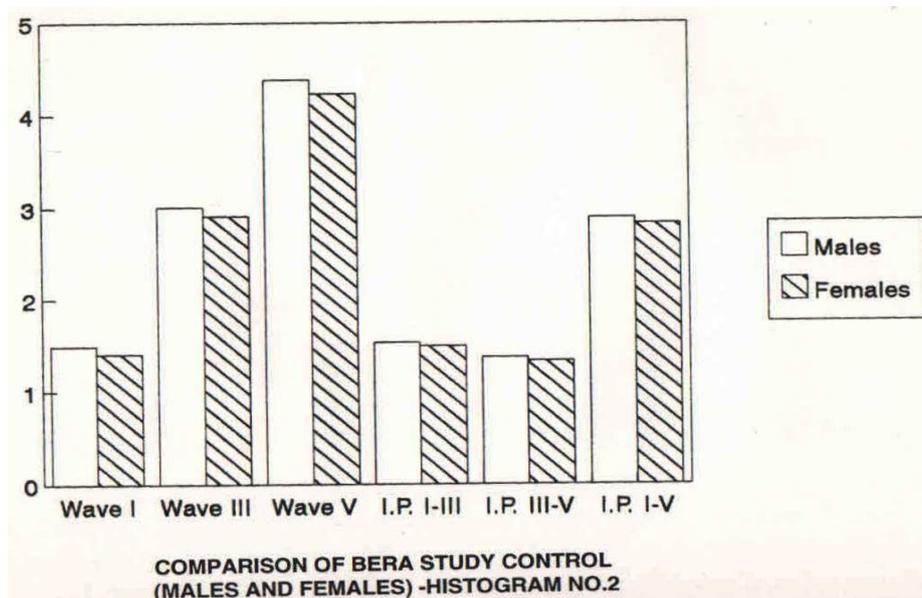
Whereas Absolute Latencies of Wave I,III,V in group I were compared for age & sex but no statistically significant results were found (Histogram – 2)

The interpeak latencies of wave I-III, III-V& I-V in group-I were 1.507 +/-0.94, 10347 +/- 0.159 & 2.857 +/- 0.181 MSc respectively. The interpeak latencies of wave I-III, III-V& I-V of group –I were compared age & sex wise but no statistical significance difference was found (Histogram no 2). The Absolute latencies of wave I, III, V of group II i.e. patients were compared for age & sex wise statistically no significant results were found (Histogram no 4). The interpeak latencies of wave I-III, III-V& I-V in group II were compared age & sex wise no statistical significant results were found (Histogram no 4).

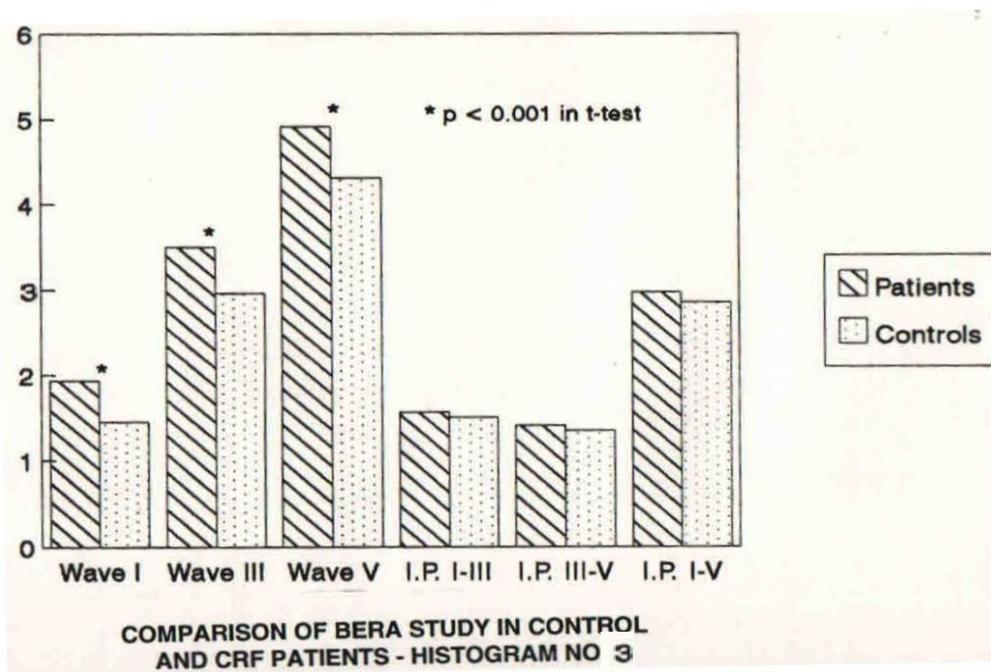
The Comparison of absolute latent periods of wave I, III, V between group I & group II were made which shows statistically significant results with P value < 0.001 for all waves I, III, V shown in table III, IV&V (histogram no-3). Whereas the comparison of interpeak latencies of wave I-III, III-V & I-V were done between group I & group II no statically significant results were found with P value > 0.05 .(histogram no -3)



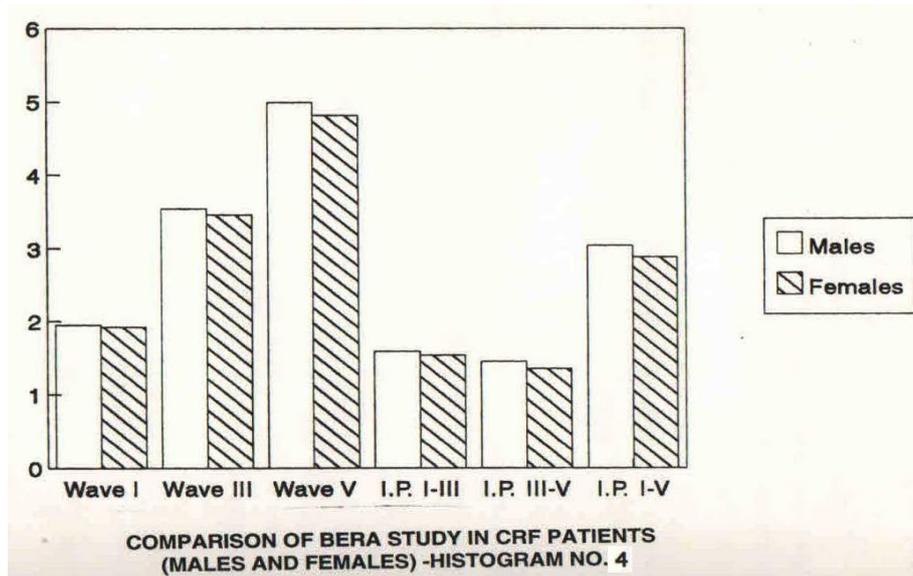
COMPARISON OF PTA IN CONTROL AND CRF (MALES AND FEMALES) –Histogram no-1



HISTOGRAM 2



HISTOGRAM 3



HISTOGRAM 4

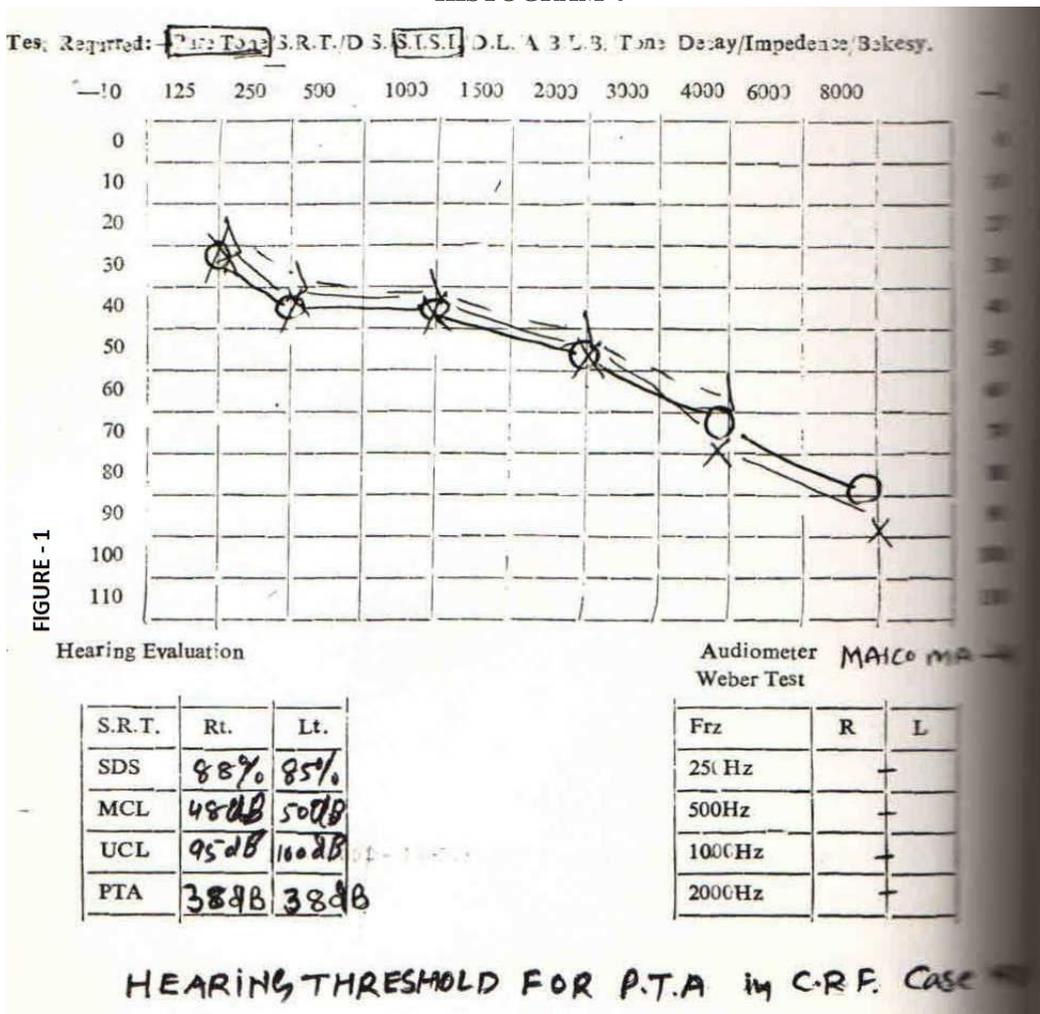


Fig 1

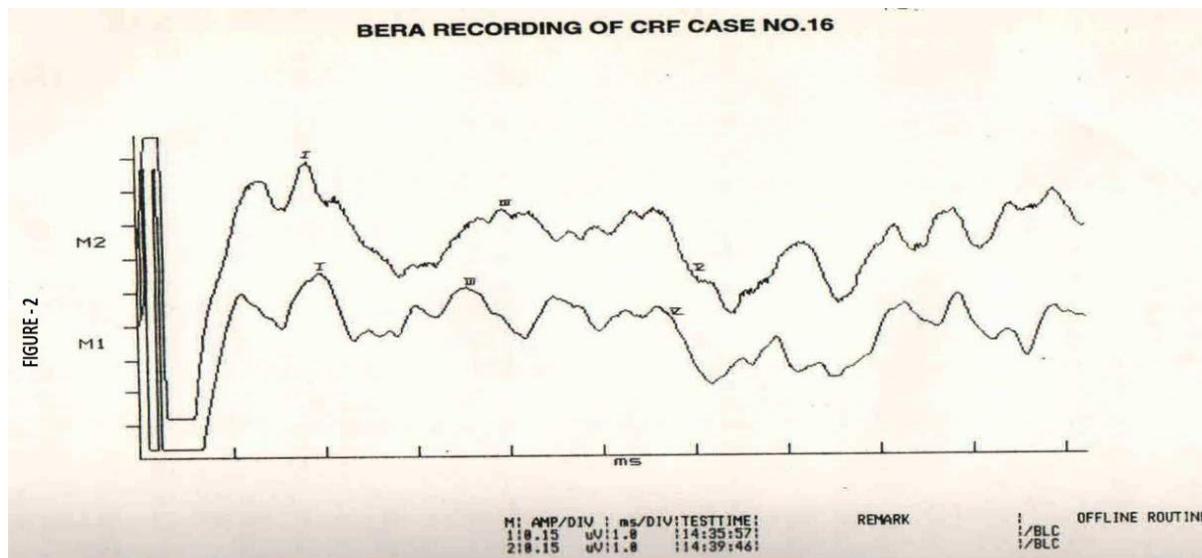


Fig 2

Table 1: Hearing Threshold for Pure Tone

AUDIOMETRY (PTA) db IN GROUP-I

GROUP	AGE	SEX	PTA
MEAN	52.33	15M/15F	18.92db
S.D.	6.88	-----	0.86

Table 2: Hearing Threshold for Pure Tone

AUDIOMETRY (PTA) db IN GROUP-II

GROUP	AGE	SEX	PTA	SISI
MEAN	45.90	17M/13F	28.60db	0.70
S.D.	10.35	-----	5.36	0.46
ERROR	1.89	-----	0.97	0.08

Table 3: Comparison of Absolute Latency of Wave –I in Group-I and Group –II

GROUP	N	MEAN	+/-S.D	t VALUE	P VALUE
GROUP II	30	1.937	+/-0.169#	10.157	<0.001
GROUP I	30	1.450	+/-0.201		

N = no of observations

t = Difference between two values.

= Difference is statistically significant when compared with group-I. (p<0.001)

Table 4: Comparison of Absolute Latency of Wave –III in Group-I and Group –II

GROUP	N	MEAN	+/-S.D	t VALUE	P VALUE
GROUP II	30	3.503	+/-0.397#	6.757	<0.001
GROUP I	30	2.960	+/-0.190		

N = no of observations.

t = Difference between two values.

= Difference is statistically significant when compared with group-I. (p<0.001)

Table 5: Comparison of Absolute Latency of Wave –V in Group-And Group –II

GROUP	N	MEAN	+/-S.D	t VALUE	P VALUE
GROUP II	30	4.910	+/-0.282#	9.171	<0.001
GROUP I	30	4.307	+/-0.224		

N = no of observations

t = Difference between two values.

= Difference is statistically significant when compared with group-I. (p<0.001)

DISCUSSION:

The present study was conducted on 30 controls as group-I and 30 chronic renal failure patients as group-II. Statistically there was no difference in auditory function in age & sex of both groups. So the patients of both sexes and age groups have been clubbed together for final evaluation of the study. In the present study in group-I individuals with mean age of 52.33 yrs there are 15 males and 15 females. Their mean hearing threshold for pure tone audiometry was 18.92 db which is within the normal hearing range and no age and gender relationship was achieved for pure tone audiometry in this group (Histogram no – 1)

The absolute latencies of wave I, III, V and inter peak latencies of wave I-III, III-V & I-V were compared for age & sex in this group but no statistical significant difference was achieved in this group-I. Histogram no - 2 Beagley and Sheldrake in 1978 [20] studied their data in relation to sex difference for all age groups and found negligible difference for absolute latencies. Lolas *et al.*; 1979 [21] and Mogensen and Kristensen in 1979 [22] found no difference between recording from males and females of their normal material from 27 subjects. Rosenheamer *et al.*; in 1980 [23] did not find significant latency differences between males and females. As compared with our study. Jerger and hall in 1980 [24] reported shorter and inter peak latencies in Brain Stem Evoked Response Audiometry recording in females than males. They speculated this difference due to relatively smaller dimension of female central nervous system and hence the neural transmission time of ABR is reduced.

In the present study of group –II i.e. chronic failure patients which include 17 males i.e. (57%) and 15 females (43%) of mean age 45.90 yrs. Their hearing threshold for pure tone audiometry was 28.6 +/-5.36, which is statistically significant and the recruitment test was present in 23 (71%) out of 30 cases signifying cochlear lesion (Figure 1). The maximum hearing loss at higher frequencies was found in age group ranging from 30 to 60 yrs on pure tone audiometry which was bilateral, symmetrical and sensor neural therefore the mean of both ears was calculated for final results. (Figure – 1) whereas this study didn't show any

significant relationship for age & sex in this group for pure tone audiometry (Histogram no 1). These observations are comparable with the observations made by other authors. Ransom *et al.*; in 1966 [25] found deafness to be present in 65% of cases. Whereas Bergström *et al.*; in 1973 [5] found deafness in 43% cases of renal failure. The observations made by Yassin *et al.*; in 1970 [9] and Pandhi *et al.*; in 1980 [26] are not in accordance with the observations made herewith who found comparatively higher incidence of deafness in patients of renal failure. Yassin *et al.*; in 1970 [9] observed normal hearing in 12.7% cases mild loss in 12.7 moderate loss in 30.9% cases severe in 26.8% cases profound in 16.9% cases of renal failure. The observation of hearing loss found to be more at higher frequencies in our study is also in accordance with the observations made by the Grahe in 1924 [27], Wigned *et al.*; in 1972 [10], Kopsa *et al.*; in 1972 [28], Mitschke *et al.*; in 1975 [29] Johnson and Mathog in 1976 [11].

Pandhi *et al.*; in 1980 [26] described that there must be some metabolic and biochemical change occurring in the inner ear producing the changes in audio vestibular apparatus. Oda *et al.*; in 1976 [8] studied 14 temporal bones of chronic renal failure patients and observed change in the outer hair cells and spiral ganglion cells. The brain stem evoked response audiometry studied was considered to be superior over pure tone audiometry for determining the site of lesion and conduction study so the wave pattern of study was compared in both groups I & II. In our study the mean absolute latent period of wave I in group was 1.450+/-0.201 MSc and in group II was 1.937 +/-0.169 and t value 10.15 so there was a delay of 1.5msec. Which was statistically highly significant with P value of <0.001. The mean absolute latent period of wave III in group –I was 2.96+/- 0.19msc and in group II was 3.503+/-0.397msc t value 6.757 which was statistically significant with P value of <0.001 the mean absolute latent period of wave V in group I was Wave V 4.31+/-0.22msc and group II was Wave V 4.910+/- 0.282msc whit t value of 9.171 P< 0.001 which is also statistically significant with P value of <0.001 (Histogram no-3). In our study the highly statistically significant delay in all waves from I to V with P<0.001 figure - 2 are comparable with results of Albertazzi *et al.*; in 1981

[30] that the patients with CRF revealed prolonged BERA latencies. Though a significant delay in waves I through V have been suggested to represent a disorder with in central nervous system [31] but the significant delay in III & V in this study seems simply due to marked latency of wave I passed on to the succeeding waves. The mean of inter peak latencies of wave I-III, III-V and I-V in group-I and group-II were compared respectively but no statistically significant difference was achieved with p value of $p > 0.05$ histogram no-3 Which is same as established by U Gafter *et al.*; in 1989 [19].

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