Dedicated to my husband

Oscar

And son

Matthew,

Thanks for your support

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PREVALENCE OF HEARING LOSS IN PATIENTS WITH CHRONIC RENAL FAILURE AND EFFECT OF HAEMODIALYSIS ON HEARING IN KENYATTA NATIONAL HOSPITAL

Researcher: DR RACHEL GACHAMBI MWANGI

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ENT DEPARTMENT KNH

DECLARATION

This is my original work and has not been presented for a degree in any other university.

Signed _____ Date 22/11/2012

Dr Rachel Gachambi Mwangi

This thesis will be supervised by:

Signed _____ Date 22/11/12

Professor I.M Macharia

Associate Professor

Department of Surgery University of Nairobi

Signed _____ Date 22/11/2012

Dr Musa Kipingor

Consultant ENT Surgeon

ENT Department KNH

DEPARTMENT OF SURGERY
COLLEGE OF HEALTH SCIENCES
P. O. Box 19676 - 00202 KNH
NAIROBI
TEL: 2722890 / 2726300, Ext. 43773

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ACRONYMS AND ABBREVIATIONS

ABR- Auditory brainstem response

AEP- Auditory evoked potential

BUN- Blood, urea, nitrogen

CAPD- Continuous ambulatory peritoneal dialysis

CRF- Chronic renal failure

dB- Decibels

DPOAE- Distortion product otoacoustic emissions

HD- Haemodialysis

HL- Hearing loss

Hz- Hertz

KHz- Kilo hertz

K^+- Potassium

Na^+-Sodium

Ca^{2+}- Calcium

KNH- Kenyatta National Hospital

PTA- Pure tone audiometry

SNHL- Sensorineural hearing loss

SPSS- Statistical package for the social sciences

ABSTRACT

Background: Patients suffering from chronic renal failure have been found to have a higher incidence of sensorineural hearing loss as compared to the general population. The purpose of this study was to determine the prevalence and patterns of hearing loss in patients with chronic renal failure at Kenyatta National Hospital, which has the largest public renal dialysis department in Kenya.

Broad Objective

To determine the prevalence and pattern of sensorineural hearing loss in patients with chronic renal failure.

Study design

Nested Case Control Study

Methodology

A cohort of patients with chronic renal failure was used for the purpose of this study from KNH renal unit and clinic, between November 2011 and February 2012. Two PTA's were performed on each patient four weeks apart which is the time it takes to do seven sessions of haemodialysis. Creatinine levels and duration of chronic renal failure was recorded.

Data Collection and Analysis

Data was collected by the principle researcher and entered in a preformatted data collection sheet. Data was entered and cleaned in Microsoft Excel software and then exported to SPSS version 17.0 for analysis.

Results

Seventy eight patients were used in this study and overall 55.1% of the chronic renal failure patients were found to have hearing loss. Mild SNHL accounted for 51.2% of those with hearing loss with a significant number of them having high frequency HL. We found a correlation between creatinine levels and pure tone audiometry findings. Patients with longer duration of illness were found to have higher degree of hearing loss.

Conclusion

Chronic renal failure causes SNHL with the duration of illness worsening the hearing loss. High creatinine levels were found to affect hearing in the conservative group of patients not undergoing HD but not in the patients on HD treatment.

BACKGROUND

Chronic kidney disease is defined as either kidney damage or a decrease in kidney glomerular filtration rate (GFR) of less than 60ml/min/1.73m^2 for three or more months by the Kidney Disease Outcomes Initiative (K/DOQI) of the National Kidney foundation [1]. The same guidelines are used at the KNH renal unit. Patients can be managed conservatively on medication or undergo either haemodialysis or continuous ambulatory peritoneal dialysis (CAPD). Some patients get renal transplantation although it is not a common procedure in Kenya. At the KNH renal unit, patients with a GFR of less than 15ml/min/1.73m^2 undergo haemodialysis according to the K/DOQI guidelines [1].

Almost every organ in the body is affected by chronic renal failure including the inner ear. Sensorineural hearing loss is the most common pathology of the inner ear, followed by vestibular dysfunction [2]. This may not always be clinically evident [3]. There are similarities between the stria vascularis of the cochlea and the nephron of the kidney that explain why the kidney and inner ear are affected in the same way. First, during embryogenesis the inner ear and kidney are influenced by the same genetic factors hence in hereditary syndromes such as Branchio-otorenal and Alport's syndrome patients have hearing loss and kidney disease[4]. At the structural level the basement membrane is found closely apposed to the endothelium in the Bowman's capsule, proximal renal tubule and the stria vascularis of the cochlea [5]. Therefore if osmotic alterations damage the capillary endothelium in the kidney, the same would happen to the cochlea causing sensorineural hearing loss. In support of this active transport of fluids and electrolytes is accomplished by the stria vascularis in the cochlea and glomerulus in the kidney [6].

It has been found that the kidney and the cochlea are affected in the same way by certain drugs e.g. aminoglycosides are both nephrotoxic and ototoxic [5]. Loop diuretics commonly used in CRF e.g. Furosemide cause reversible SNHL by altering the metabolism of the stria vascularis, resulting in alteration of endolymphatic ion concentration. This shows that there are other risk factors implicated with hearing loss in chronic kidney disease including: ototoxic medication, electrolyte imbalance, hypertension [7], and haemodialysis itself [8]. Joselen Ransome et al [9] did a post mortem on a patient who had CRF and underwent HD. The histopathological report on temporal bone sections showed gross degeneration of the organ of Corti and stria vascularis. Reissner's membrane was thickened and they also reported ruptured disorganized endolymphatic sacs. They came to the conclusion that degeneration of the organ of Corti was sufficient explanation for SNHL in CRF.

Hearing loss in this patient was attributed to several factors. First that it would be due to generalized neuropathy caused by renal failure. Secondly that it was due to osmotic disturbances due to HD itself. Dialysis in a patient with high blood urea brings about a fall in the urea content of the extracellular fluid. The resulting imbalance between the extracellular and intracellular urea levels is then corrected by a diffusion process in the initial stages of which water passes into the cells by osmosis. It was then argued that the osmotic disturbances to which the cells were subjected to may have a serious damaging effect, "dialysis disequilibrium syndrome".

Polybrene/Hexadimethrine bromide is a quaternary ammonium salt that runs in the HD machine has been described by Haller et al [10] as being ototoxic. The drug would seem likely to damage the vessels of the inner ear probably by causing small vessel obstruction hence SNHL. Polybrene also produces anoxic degeneration of the stria

vascularis with consequent derangement of the water/electrolyte mechanism of the endolymph system.

LITERARTURE REVIEW

Effects of chronic renal failure on hearing

The prevalence of SNHL in patients with chronic kidney disease has been reported to be as high as 77% [11]. Hearing loss in chronic renal failure has been verified in newer studies [8, 12, 13, 14]. In a study by Kusakari et al [15], in 229 patients on chronic haemodialysis they found that 36% had vestibular dysfunction, 60% had hearing loss and 26% had a combination of both. The inner ear is the one that was affected in this study

Zeigelboim et al [13] did a study on 37 subjects with CRF undergoing conservative management and compared with a control group. They measured thresholds between 9 and 18 KHz and concluded that a more severe high frequency HL was present in the group with CRF and seemed to worsen further a year after the 1st assessment. Stravroulaki et al[14] found that 55.5% of children with CRF had high frequency HL mainly at 12 KHz. DPOAEs amplitudes were smaller among children with CRF even at frequencies where hearing was normal. OAEs were absent or smaller among the CRF patients. Charachon [16] found changes in the cochlea in 75% of 54 study subjects with CRF. This was a histopathological study.

Warady et al [17] did a case control study on 14 patients with CRF. Overall hearing loss was found to be worse in patients with chronic renal failure than the controls. Auditory function seems to be affected by CRF in all studies so far [18]. Ikeda et al [19] did a study on

guinea pigs where he induced renal failure and measured cochlea potentials at 1, 2 and 3 months post operatively and concluded that CRF affects the cochlea hair cells. In support of this study Shvili et al [20] induced CRF in rats and measured ABR after three months. They found prolongation of wave I with normal interpeak latency suggesting the site of damage was at the cochlea or along the proximal part of the acoustic nerve. There are no human studies as yet of the same type.

Effects of haemodialysis on hearing

Nikolopoulos et al [21] checked auditory function among 46 children with CRF, 15 on HD, 22 with pre-end stage renal disease and 9 on CAPD. They found 41.3% had HL. It was mostly impaired in the high frequencies with 30% of the ears affected to a lesser degree in the middle and low frequencies. Forty one percent of the children in the HD had HL, 32% in the pre-end stage renal insufficiency and none in the CAPD group. Samir et al' [22] findings that children on HD suffered more than children on conservative treatment were consistent with Nikolopoulos et al.

Marsh et al [23] recorded AEPs, from two groups of patients: 14 patients on HD and 13 on CAPD and compared those with a control group, they found differences in brainstem responses and concluded that patients on CAPD had function closer to normal than those on HD. Kligerman et al [3] recorded findings of HL in CRF and found that in 54% of the patients {15 of 28} there was HL at high (greater than 2000Hz). The cochlear being the site of destruction. They found an association between hearing loss and duration of dialysis. In 67% of the patients on HD for more than 18 months there was HL while it

occurred in 30% of patients who had been on dialysis for less than 18 months.

All the above studies show that the type of treatment has an impact on hearing on CRF patients; however other reports present conflicting findings concerning possible contributions of HD treatment to hearing loss. Ozutram and Lam [6] examined the effects of a single session of HD on pure tone thresholds and DPOAEs. They tested patient's aged 19-45 years prior and following one session of HD. They found no significant changes in the pure tone thresholds or the DPOAE amplitude in their study. Ozen et al [24] reported an improvement of 20Db in the hearing of patients following HD. They suggested that changes in serum osmolality, BUN and fluid retention may reverse the hearing impairment post dialysis. Gartland et al [25] recorded pure tone thresholds in 31 patients before and after a of session haemodialysis. They included 125Hz in their audiogram and documented a low frequency HL that improved significantly on a third of the patients after HD. Pagani et al [26] recorded auditory evoked responses from patients on HD for less than 5 years, between 5 and 10 years and more than 10 years. They found evidence of pathology along the auditory pathway in the CRF groups, with no indication that the length of dialysis treatment or the length of the disease may exacerbate this pathology.

Correlation of hearing loss with blood tests and disease duration

Mancini et al [27] did a study where they compared hearing loss in children with congenital kidney disease and those with renal failure due to acquired causes. Only 21% of children with acquired as

compared to 47.5% with congenital causes had hearing loss. They showed that the longer the duration of illness the higher the risk of developing hearing loss [16]. Heinrich et al [28] followed up patients with chronic kidney disease for 4 years and found that 75% of them showed no deterioration of hearing during that period. They concluded that hearing loss does not worsen with the duration of treatment.

Samir et al found no correlation between pure tone audiometry findings and OAEs with serum electrolyte levels [22]. Kusakari et al reported that the inner ear dysfunction was not correlated with hematocrit, BUN and serum creatinine levels or with duration of haemodialysis [15]. Johnson et al [29] found no relationship between fluctuation of hearing and serum urea, nitrogen, potassium, sodium, calcium and glucose levels.

In a similar report Jorgenson[30] found that HL was not related to changes in creatinine, K^+, Na^+, Ca^{2+}, glucose, BUN, blood pressure, weight or hyperlipidemia. Shvili et al [20] recorded ABRs from patients with CRF before initiation of dialysis treatment and from patients on long term dialysis treatment; they found no correlation between ABR measures and serum urea, creatinine or duration of haemodialysis. Lasisi et al [31] did a case control study of 33 CRF patients and 28 healthy controls and concluded that, hearing loss is more common with patients suffering CRF and was related to the duration of renal disease.

JUSTIFICATION

Solutions to hearing impairment focus on prevention, early detection, management and rehabilitation. This study has helped determine the burden of hearing loss among chronic renal failure patients and those undergoing haemodialysis at KNH, which will aid in development of a management protocol for those patients with respect to hearing impairment. The early detection of hearing loss and timely management will improve their quality of life.

HYPOTHESIS AND OBJECTIVES

Null hypothesis

CRF and haemodialysis have no effect on hearing

Alternative hypothesis

CRF and haemodialysis have an effect on hearing

Primary Objective

To determine the prevalence and patterns of sensorineural hearing loss in patients with chronic renal failure.

Secondary objectives

1. To determine the effect of haemodialysis on hearing in patients undergoing haemodialysis
2. To determine the effect of creatinine levels on hearing in patients with chronic renal failure.
3. To determine the correlation between disease duration and the level of hearing loss in patients with chronic renal failure.

MATERIALS AND METHODS

The renal unit in KNH does dialysis on an average of 25 patients a day. At least two new patients are dialyzed every day. The majority of the patients are adults. Cohorts of patients with CRF were used in this study. The additional risk factor to HL in these patients was haemodialysis.

Patients were selected randomly from the renal unit and renal clinic. The cases were newly chronic renal failure patients scheduled to start dialysis. A pre-haemodialysis PTA was done and a second one after seven sessions of HD. The controls were CRF patients on conservative management being followed up in the renal clinic. They were patients who were stable and did not require haemodialysis. Two PTA's were done on them, one after giving initial consent and the second one after four weeks which is the average time it takes for seven sessions of haemodialysis to be done on a new patient with CRF. The cases and controls were matched for age and sex. The duration of chronic renal failure and creatinine levels were documented at the time each PTA was done.

Pure tone audiometry was conducted by one trained audiologist using audiometer model AC33 in a sound proof insulated room at the ENT department to avoid inter-personal and inter-instrument bias. Pre- existing middle ear pathology was ruled out from the history and examination (Otoscopy, tuning fork tests) .Patients on haemodialysis were using the same type of machine. Creatinine levels were recorded during the 1st PTA and when the second PTA was done. Duration of illness was also recorded.

Exclusion Criteria:

- Congenital hearing loss

- Previous treatment for ear pathology
- Age greater than 55 years to exclude presbycusis
- History of continuous exposure to noise
- Previous history of treatment with ototoxic drugs
- Patients with diabetes mellitus
- Those with uraemic encephalopathy or severe illness
- No consent

Sample size calculation.

The sample size was estimated using the following formula:

$$N = \frac{\{Z_\alpha \sqrt{(P_0 q_0)} + Z_\beta \sqrt{P_1[1+R-P_1(1+R^2)]}\}^2}{\{P_1(1-R)\}^2}$$

N – Sample size required

P_0 - Percent of unexposed (undergoing conservative treatment) with outcome (hearing loss) = 67% (Lasisi et al., 2006) [35]

q_1 - $1 - P = 33\%$

P_1 - Percent of exposed (undergoing haemodialysis) with outcome (hearing loss)

$P_1 = 1/2P_0(1+R) = 80\%$

$q_0 - 1-P_0 = 20\%$

R – Estimated relative risk of hearing loss among the patients undergoing haemodialysis compared to those on conservative treatment – 1.4

$Z_{1-\alpha/2}$ - Two-sided significance level (1-alpha)-95% = 1.96

$Z_{1-\beta/2}$ – Power (1-beta, % chance of detecting) – 80% = 0.84

By substituting into the formula

N = 35 cases and 35 controls

Sample size of 70

To cater for lost to follow up 10% has been added making the sample size **78**

ANALYSIS

Data was entered and cleaned in Microsoft Excel software and then exported to SPSS version 17.0 for analysis. The baseline characteristics of the patients were described using age, sex, duration of illness and creatinine levels. Age was analyzed using mean and standard deviation and comparison between the two groups using Student's t test. Gender of the patients was presented as a percentage of the number of cases and controls. Comparison between the groups was done using chi square test. Similarly, duration of illness and creatinine levels were analyzed and presented as means and standard deviations, then compared between the cases and controls using Student's t test.

The prevalence of sensorineural hearing loss was analyzed and presented as frequency distribution indicated as a proportion of all the patients with chronic renal failure. The difference in hearing loss between cases and controls at baseline and after 4 weeks was determined using chi square test of association while the change within each group after 4 weeks was tested using Wilcoxon Signed Rank test. SNHL was associated with creatinine levels and duration of illness by comparing the medians of creatinine levels and duration of illness using Mann Whitney U test. Statistical significance was interpreted as a P value$\leq$0.05. Odds ratios were used to estimate the risk of developing an outcome among cases as compared to the controls.

RESULTS

Descriptive Analysis

Seventy eight patients were recruited in the study between November 2011 and March 2012. The baseline characteristics are shown in table 1, below. Age was significantly higher among the controls than cases owing to the fact that the controls had a longer duration of illness, with an average of 44.2 years for the controls and 39.4 years for the cases.

The patients were matched for age and sex. There was no statistical difference between the cases and controls in relation to gender using the Chi Square test. Males accounted for 59% of the patients. The duration of illness was significantly lower among the cases than the controls with a median time of 2.1 weeks for the cases and 312.9 weeks (6years) for the controls.

The creatinine levels at baseline were much higher for the cases than the controls with an average of 1104mmol/l for the cases and almost a third of that for the controls

Table 1: Baseline characteristics

Variable	Cases	Control	OR (95% CI)	P value
Age	39.4 (8.5)	44.2 (7.1)	-	
Sex, n (%)				
Female	16 (41.0)	16 (41.0)	1.0 (0.4-2.5)	
Male	23 (59.0)	23 (59.0)	1.0	
Duration of illness (weeks)				
Median (IQR)	2.1 (1.4-4.3)	312.9 (208.6-469.3)	-	<0.001
Creatinine levels, Mean(SD)				
At baseline	1104.6 (176.0)	346.5 (81.9)	-	<0.001
After 4 weeks	831.4 (128.1)	337.7 (82.0)	-	<0.001

Prevalence of SNHL in patients with CRF

SNHL at baseline for the cases and controls

Cases were less likely to have hearing loss than the controls (this is indicated by an odds ratio of less than 1)

Table 2: SNHL at baseline

	Cases	Control	OR (95% CI)	P value
PTA, n (%)				
Normal	25 (64.1)	10 (25.6)	1.0	
Mild SNHL	10 (25.6)	12 (30.8)	0.3 (0.1-1.0)	0.053
Moderate SNHL	4 (10.2)	15 (38.5)	0.1 (0.0-0.4)	0.001
Severe SNHL	0	2 (5.1)	-	0.999
Profound	0	0		

The prevalence of SNHL in patients with CRF was found to be 55.1%. The WHO audiometric descriptor was used to assess the hearing level. Patients with mild SNHL accounted for most of the patients with hearing loss. There were no patients found to have profound HL. 19 of the 43 (44.2%) subjects found to have HL had high frequency hearing loss ranging from 2-8 KHz.

Figure 1: Graph comparing prevalence of SNHL between cases and control

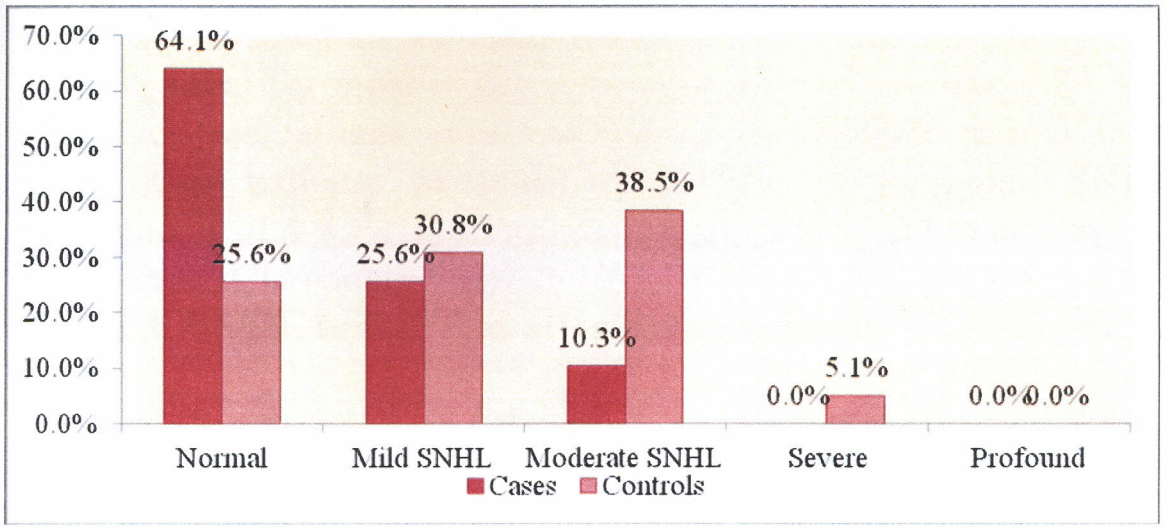
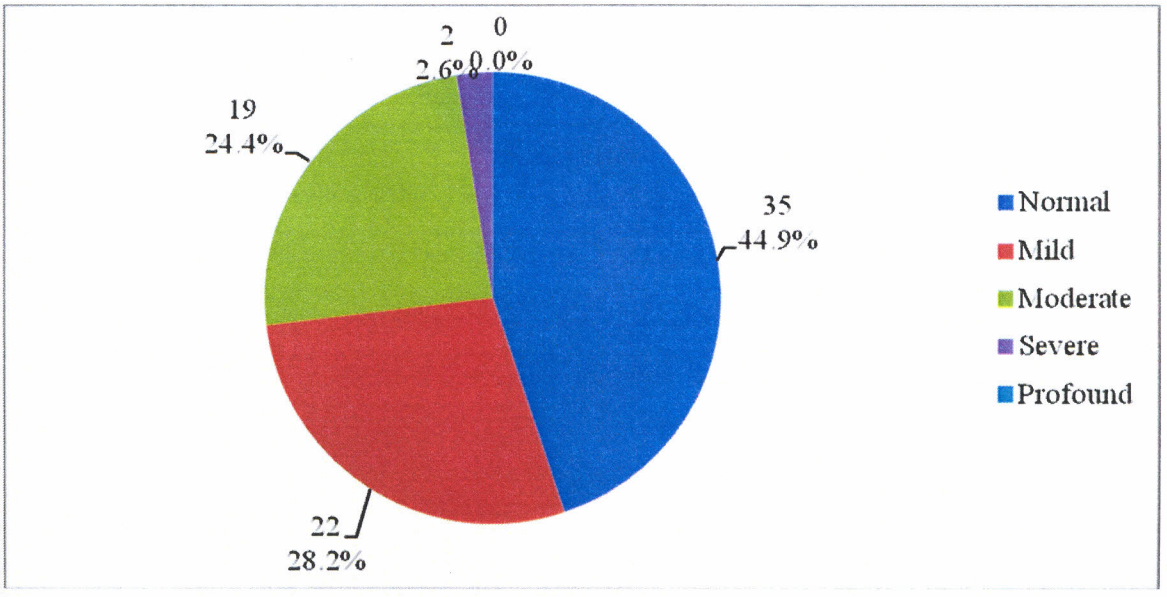


Figure 2: Pie charting showing distribution of SNHL according to the WHO audiometric descriptor



Effect of Haemodialysis on hearing

After seven sessions of haemodialysis there was no change in the hearing level for most of the patients from the baseline PTA values. However two patients improved from mild SNHL to normal hearing. Two other patients worsened from mild to moderate SNHL at frequencies of 4-8 KHz, although this was not found to be statistically significant (Chi square test).

Table 3: SNHL before and after haemodialysis

	Baseline	**After 4 weeks/Seven sessions of HD**	**P value**
PTA, n (%)			
Normal	25 (64.1)	27 (69.2)	1.000
Mild SNHL	10 (25.6)	6 (15.4)	
Moderate SNHL	4 (10.2)	6 (15.1)	

There was no change in hearing from the baseline characteristics for the patients on conservative management (Chi Square test)

Table 4: SNHL after 4 weeks for patients on conservative treatment

	Baseline	**After 4 weeks**	**P value**
PTA, n (%)			
Normal	10 (25.6)	10 (25.6)	1.000
Mild SNHL	12 (30.8)	12 (30.8)	
Moderate SNHL	15 (38.5)	15 (38.5)	
Severe SNHL	2 (5.1)	2 (5.1)	

Effect of creatinine levels on hearing in patients with chronic renal failure

Hearing loss was significantly associated with high Creatinine levels among patients on conservative treatment (Mann Whitney U test was used to compare the medians)

Table 5: Patients on conservative treatment

Variable	SNHL at baseline		P value
	Mild-Severe	Normal	
Median creatinine levels (IQR)	376 (299-400)	247 (212-332)	0.004

In patients who underwent haemodialysis, there was no significant difference between patients with hearing loss compared to those with normal hearing (Mann Whitney U test was used to compare the medians).

Table 6: Patients on haemodialysis

Variable	SNHL at baseline		P value
	Mild-Severe	Normal	
Median creatinine levels (IQR)	1049 (970-1210)	1100 (980-1267)	0.235

Correlation between disease duration and the level of hearing loss in patients with chronic renal failure

Patients with hearing loss had been sick for a significantly longer duration than those with normal hearing (Mann Whitney U test was used to compare the medians)

Table 7:

Variable	**SNHL at baseline**		**P value**
	Mild-Severe	**Normal**	
Duration of illness (weeks) Mean (SD)	208.6 (6.0-417.1)	2.6 (1.4-52.1)	<0.001

DISCUSSION

Prevalence of SNHL in chronic renal failure

The inner ear in patients with chronic renal failure is susceptible to injury from various insults like, drugs, hypertension, and haemodialysis amongst others. The concurrent presence of all these factors makes it difficult to come to a conclusion on the significance of each variable [25, 32].

In this study a prevalence of 55.1% of SNHL was found in patients with chronic renal failure. The patients on conservative management were found to have a higher prevalence of SNHL (74.4%) as compared to the cases (35.9%). Although the cases were sicker and had much higher levels of creatinine, they had a much lower prevalence of hearing loss; this can be attributed to the fact that the patients on conservative management had chronic renal failure for longer. In this study we were able to determine that the chronicity of the disease had a great impact on damage to the cochlea. These results are comparable to Kusakari et al who found a prevalence of 60%. Bergstrom and Thompson et al [5] in a prospective study found 47% of their 151 subjects had HL. Charachon et al [16] found a prevalence of 75% [19] while Bazzi et al [11] found a prevalence of 77% . Charachon did a clinicopathological study on temporal bones, preservation of the bones could have led to some changes on the cochlea therefore not really giving the true picture on hearing loss

In this study 44.2% of the patients had high frequency HL. This is comparable to most studies. Gatland et al found 53% of his patients to have high frequency HL [28]. Ozutran et al reported a notch at 6 KHz in patients with chronic renal failure [6].

Mild SNHL were found to be the most frequent (51.2%), followed by moderate SNHL (44.2%) and severe 4.7%. These results are similar to

the ones found by Sharma R et al who reported mild SNHL as 44.73% and moderate as 42.1% [33].

Effects of haemodialysis on hearing in CRF

After seven sessions of haemodialysis there was no change in the hearing level for most of the patients (87.2%) from the baseline PTA values. However two patients improved from mild SNHL to normal hearing. Two other patients worsened from mild to moderate SNHL at frequencies of 4-8 KHz, although this was not found to be statistically significant (P value= 1.000). This can be attributed to the fact that these four patients were sicker than the rest, therefore it is possible that the first PTA was not the true picture. After being on haemodialysis after a few weeks the patients were able to give a more objective response during audiometry. For the controls after 4 weeks which corresponds to the time it takes to do seven sessions of HD there was no change in hearing level. So far this is the only nested case control study done on this subject making the results more credible. It seems that seven sessions of haemodialysis are too few to cause any changes to the cochlea.

The results are comparable to most studies done after a few sessions of HD. Visenscio and Gerber et al [34] did PTA on their patients after 5 sessions of HD and showed no effect on hearing. Similarly Nikolopoulos et al [21] did a study on 9 subjects after one HD session. We concluded that CRF itself is what causes damage to the cochlea and not HD. It can also be argued that may be if we used ABR we would have been able to detect the most subtle change in the hearing level such as in several other studies done [35,36,37]

Correlation between disease duration and the level of hearing loss in patients with chronic renal failure

In this study we found that most of the subjects with HL had a longer duration of illness, with a median of 208.6 weeks (4 years) as compared to the ones with normal hearing with a median of 2.6 weeks. Using the Mann Whitney U test we got a P value of less than 0.001 which is statistically significant.

Nineteen of the 25 patients (76%) who had CRF for 5 or more years had hearing loss ranging from mild to severe. Two of the patients had severe HL. All the patients (9) who had CRF for more than ten years had HL. This study emphasizes the fact that it is long duration of exposure to the illness that damages the cochlea as compared to the acute effects. These results are comparable to other studies. Kligerman et al [3] found that 67% of the patients who had CRF for more than 18 months had HL as compared to 30% of the patients who had been followed up for less than 18 months . Mancini et al[27] found that 47.5% of the patients with congenital kidney disease had HL as compared to the 21% of the ones with acquired kidney disease.

Effects of creatinine on hearing in CRF

Only a few studies have been done to correlate HL in chronic renal failure and creatinine levels. Kusakari et al, Johnson et al and Jorgenson et al found no relationship between HL in CRF and creatinine levels [15,29.30]. In this study a correlation between CRF and creatinine levels in the conservative group was found. Mann Whitney U test was used to compare the medians of the creatinine levels in the conservative group. Those patients with HL had a median of 376 as compared to the normal 247 mmol/l with a P value of 0.004. We found that, the higher the level of creatinine the more likely it was for

the subject to have hearing loss. On the other hand we found no relationship between creatinine levels and hearing loss in the newly diagnosed patients i.e. even though their creatinine levels were significantly high. The longer duration of exposure to high levels of creatinine explains these results.

CONCLUSION

The overall prevalence of SNHL in patients with chronic renal failure was found to be 55.1%. Most of the patients had mild SNHL 51.2% while 44.2% had hearing loss at high frequency (2-8 KHz). These results are comparable to most studies.

The duration of illness determined the degree of HL with those who were sick for longer being more affected. We found that after seven sessions of HD there was no change in hearing level and came to a conclusion that HD has no effect on hearing. Although at recruitment the patients who were going to undergo haemodialysis had very high creatinine there was no correlation with severity of HL. On the other hand the patients on conservative management who had been followed up for a longer period (median=208.6 weeks) had a correlation of HL with the hearing level (p value <0.001).

LIMITATIONS

The only audiometric method used was PTA which is not as sensitive as ABR in detecting HL. Probably if hearing level was assessed using ABR the detection of any changes in HL after HD could have been higher

RECOMMENDATIONS

1. Patients with CRF should have hearing assessment done at the time of diagnosis and then followed up thereafter. Hearing assessment should be done at least once a year.
2. Those patients found to have debilitating HL should have hearing aids to improve their quality of life.
3. Another study should be done using ABR to assess the effects of haemodialysis on hearing.

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APPENDIX

1. CONSENT EXPLANATION

ENGLISH

My names are Dr Rachel Mwangi. I am a post graduate student in the department of Ear, Nose and Throat Surgery (clinic no. 34)

I am doing research on the effects of chronic renal failure (what you're suffering from) on hearing. Hearing loss has a number of causes, including: ear infections, continuous exposure to loud noise, drugs such as the one you're using now (Lasix), high blood pressure and diabetes.

The kidney and the ear have some similarities, therefore in some people when the kidney is affected so is the ear. In this research we will be asking you a few questions on your hearing and also doing hearing tests which are not painful and have no side effects. We will also be documenting your routine tests (creatinine levels) and duration of illness.

For those of you who will not have done the blood tests, with your permission I will withdraw blood from you and take it to the lab for creatinine levels to be analysed. All this will not cost you anything extra from what you normally spend on your illness.

This will be beneficial to you because if there is a problem with your hearing we will follow you up in our Ear, Nose and Throat clinic regularly and advice you on the appropriate management of the hearing loss. We will discuss with the doctor who is currently following you up for the kidney problem. It is not compulsory to participate in the study. If you choose not to participate your treatment will continue as scheduled.

SWAHILI

Majina yangu ni Daktari Rachel Mwangi. Mimi ni mwanafunzi katika idara ya masikio, mapua na koo (kliniki nambari 34). Nafanya utafiti wa madhara ya ugonjwa wa figo katika masikio. Shida ya kukosa kusikia vizuri inaletwa na mambo kama ugonjwa wa masikio, sauti kubwa, dawa kama ambazo unatumia sasa (Lasix), shinikizo la damu na ugonjwa wa sukari. Kwa maumbile figo na sikio zinafanana kwa hivyo kama figo zako hazifanyi kazi vizuri, masikio yako yanaweza kuwa pia yameadhirika.

Katika utafiti huu utaulizwa maswali na kuangaliwa masikio, hakuna uchungu wowote au madhara yoyote wakati masikio yatakuwa yakipimwa. Kwa wale ambao hawatakuwa na majibu ya damu yakionyesha kipimo cha creatinine tutakutoa damu ukitupatia ruhusa na kupeleka katika maabara. Hauhitajiki kulipa chochote, isipokuwa yale malipo yako ya kawaida ya matibabu.

Utafiti huu utafanywa kwa hiari yako tu na usipokubali bado matibabu yako ya figo yataendelea kama kawaida.

2. CONSENT FORM

Patient number.....

Consent by patient:

I.....or Guardian/Parent..... of.....hereby give consent to be included in this study.

The nature of the study has been explained to me fully by Dr.....

Date.....Signed.....

I Dr.....confirm that I have explained to the patient the nature of the study.

Date.....signed.....

Ethics Committee Contact:

Researcher's Contact: 0725370616 Email:gachams@yahoo.com

Ethics committee: P.O BOX 20723/00202 Email: uonknh_erc@uonbi.ac.ke

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Kukubali kwa mgonjwa:

Mimi.....kutoka....., nimekubali kushiriki katika utafiti huu.

Nimeelezwa kikamilifu juu ya utafiti huu na Daktari.....

Tarehe.....Sahihi.....

Mimi daktari.....nahakikisha ya kwamba nimeelezea mgonjwa juu ya utafiti huu.

Tarehe.....Sahihi.

Anwani ya mtafiti: Nambari ya simu: 0725370616 Email: gachams@yahoo.com

Anwani ya Idara ya Ethics: SLP: 20723/0202 Barua pepe: uonknh_erc@uonbi.ac.ke

3. QUESTIONNAIRE ON THE EFFECTS OF CHRONIC RENAL FAILURE AND HAEMODIALYSIS ON HEARING

SERIAL NO...

BIODATA:

Initials...

Sex: Male ☐ Female ☐

Age.....

HISTORY

- Duration of illness.....

	NO	YES	
• History of previous dialysis	☐	☐	
• History of other chronic illnesses	☐	☐	If yes specify.....
• History of use of other medication	☐	☐	If yes specify.....

CLINICAL EXAMINATION

	Yes	No
• Otorrhoea	☐	☐

- Wax impaction ☐☐
- TM perforation ☐☐
- Facial nerve palsy ☐☐
- Tuning fork findings: Rhine's..... Weber.....
- PTA findings:
    1. Degree of HL (WHO audiometric descriptor [38])
        I. Normal (≤25Db) ☐
        II. Slight impairment (26-40dB) ☐
        III. Moderate (41-60dB) ☐
        IV. Severe (61-80dB) ☐
        V. Profound (≥ 81dB) ☐

- Levels of creatinine
  Cases: Pre-haemodialysis..... After seven sessions of HD (week 4).....
  Controls: Day one.....Week 4

4. IMPLEMENTATION TIME TABLE

PERIOD	ACTIVITY
April- August 2011	Proposal Writing
November 2011	Presentation of proposal to department

December 2011	Ethical Approval
January-March 2011	Data collection
April 2012	Data Analysis
May 26th 2012	Presentation of results

5. BUDGET

CONSIDERATION	UNIT COST	TOTAL COST(KSH)
BIOSTATICIAN		25,000
STATIONERY/PRINTING		15,000
PTA	156@700 each	109,200
CONTINGENCY		10,000
TOTAL		159,200