Results

RESULTS

The Results Of The Epidemiological Study:

The human subjects included 500 occupationally exposed workers to lead in their daily work, group(I) and 500 controls, group (II), they were sex and age matched. All subjects underwent personal histories, clinical examinations and laboratory tests to determine blood lead levels (B- pb), and free erythrocyte protoporphyrin (FEP). Pure tone hearing thresholds were traced, data from both ears of an individual subject were averaged. 50 subjects, randomly selected from group (I) were tested by brain stem evoked potentials (BAEP), also data from both ears of an individual subject were averaged. All the data were collected and statistically analysed as follows:

Age distribution of studied groups

Variable	Exposed group (no=500)	Control group (no = 500)
Age (years)		
Mean ± SD	39.08 ± 7.052	39.87 ± 6.91
Median ± Range	40.00 ± 20.00	40.00 ± 20.00
SEM	0.31	0.30

"t" value -1,81

P>0.05

Table (1): In this table, the age of the subjects of the exposed group ranged between 30 - 50 years with a mean age of 39.08 ± 7.052 years, median age of 40.00 ± 20.00 and SEM 0.31, while the age of the subjects of the control group ranged between 30 - 50 years with mean age of 39.87 ± 6.91 years, median age 40.00 ± 20.00 and SEM 0.30.

there is no significant difference in age, the groups are age matched.

Sex distribution of the studied groups.

Variable	Exposed group(no = 500) No	%	Control group (no = 500) No	%
Sex				
Male	410	82	395	79.00
Female	90	18.00	105	21.00
Total	500	100	500	100

Chi -square "X^2" (person) 1.433

df 1

P> 0.05

Table (2): In this table, there is 410 males in the exposed group (82%) and 90 females (18%), while in the controls there is 395 males (79%) and 105 females (21%).

There is no significant difference and the groups are sex matched.

Distribution of the two studied groups according to smoking.

Variable	Exposed (no = 500) No	%	Control (no = 500) No	%
Smoking status				
Smoker	**330**	**66.00**	**363**	**72.60**
Mon smoker	**170**	**34.00**	**137**	**27.40**
Total	**500**	**100**	**500**	**100**

Chi -square "X^2" (person) 5.11

df 1

P< 0.05

Table (3): In this table, there is 330 smokers in the exposed group (66%) and 170 non smokers (34%), while in the control group there is 363 smokers (72.6%) and 137 non smokers (27.4%). There is a significant difference in the number of smokers between the studied groups

Distribution of duration of exposure of studied groups.

Variable	exposed group (no = 500)	Control group (no = 500)
Duration of exposure (years)		
Mean ± SD	**14.96 ± 4.24**	**Not applicable.**
Median ± Range	**14.00 ± 15.00**	
SEM	**0.19**	

Table (4): In this table, the subjects of the exposed group were exposed to lead in their work environment from 10 - 23 years, with mean duration of exposure 14.96 ± 4.24 years, median 14 ± 15 years and SEM 0.19.

Distribution of (B - pb) level of the two studied groups:

Variable	Exposed group (no = 500)	Control group (no = 500)
Blood lead (B-pb) µg/dl		
Mean ± SD	41.22 ± 12.98	12.19 ± 5.60
Median ± Range	39.00 ± 46.00	11.00 ± 20.00
SEM	0.581	0.25

"t"-value 45.90

P<0.001

Table (5): In this table, the mean B-pb level in the exposed group 41.22 ± 12.98 µg/dl, median 39.00 ± 46.00µg/dl and SEM 0.581, while the mean B-pb level in the controls 12.19 ± 5.6µg/dl, median 11 ± 20µg/dl and SEM 0.25

There is statisticaly significant difference between both groups in (B-pb) level

Distribution of EPP of the two studied groups.

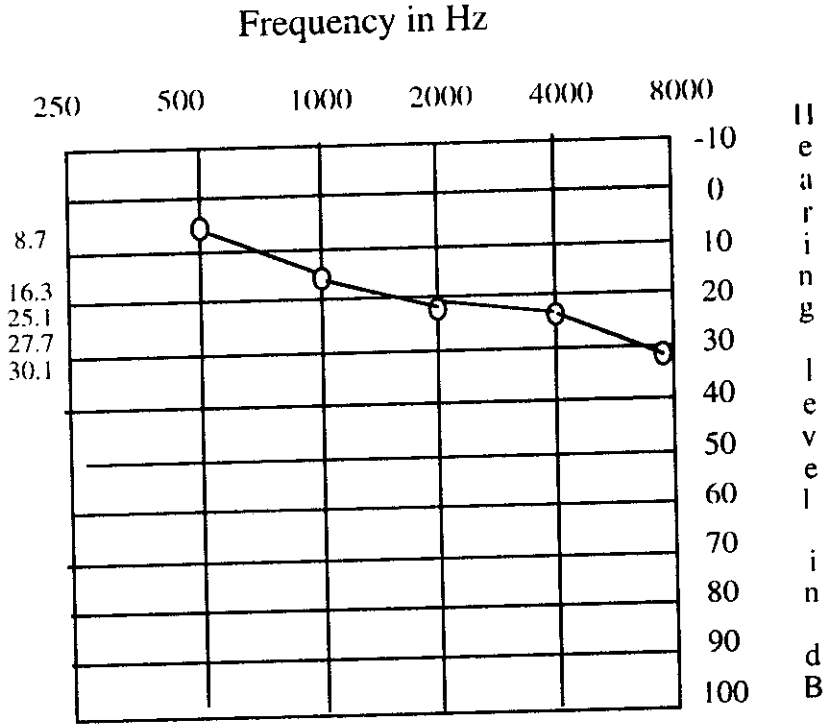
Variable	Exposed group (no = 500)	Control group (no = 500)
EPP µg/dl		
Mean ± SD	68.00 ± 39.96	20.99 ± 7.06
Median ± Range	60.00 ± 175.00	20.00 ± 26.00
SEM	1.78	0.31

"t"-value 25.90

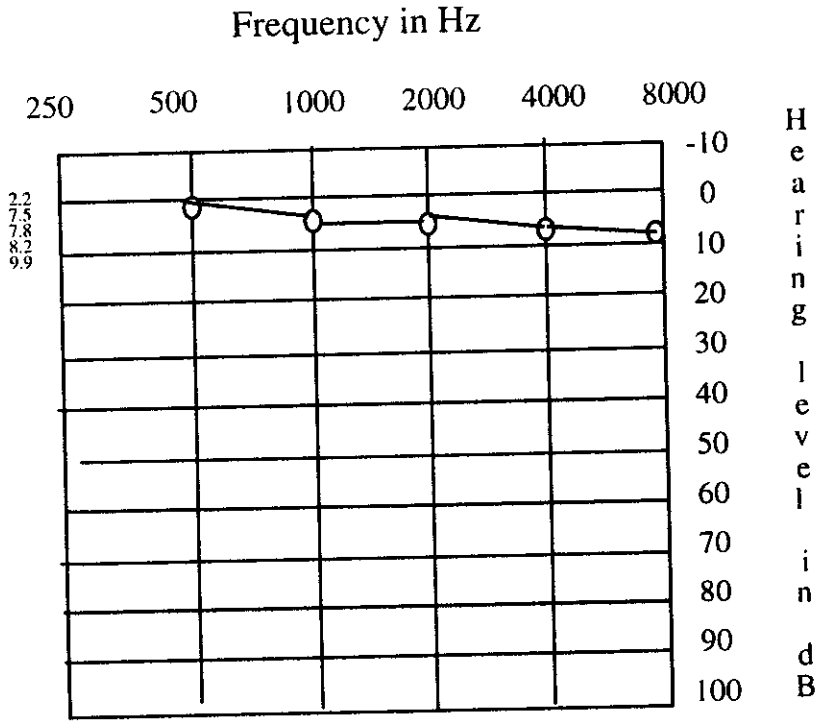
P<0.001

Table (6): In this table, the EPP in the blood of the exposed subjects with mean level 68.00 ± 39.96 µg/dl, median 60 ± 175 µg/dl and SEM 1.78, while in the controls, the mean level of EPP in the blood 20.99 ±7.06 µg/dl, median range 20 ± 26 µg/dl and SEM 0.31

There is significant difference between the two groups in the EPP level in the blood .



an audiogram showing mean HTL in exposed group



an audiogram showing mean HTL in control group

Audiometric features of the two studied groups

Frequency (Hz)	Mean ± SD of hearing threshold level (HTL) in dB		"t" Test	P Value
	Exposed group (no=500)	Control group (no=500)		
500	8.70 ± 2.19	2.27 ± 2.86	39.83	<0.001
1000	16.30±5.46	7.56± 3.93.	29.02	<0.001
2000	25.10± 10.33	7.81± 2.48	36.39	<0.001
4000	27.70± 11.24	8.26± 2.58	37.67	<0.001
8000	30.10± 11.82	9.97± 3.18	36.76	<0.001

Table (7): In this table, both groups differed significantly i.e there was statistically significant difference in both groups of the study in mean HTL at tested frequencies, the difference at 4000 Hz and 8000 Hz was apparently more conspicuous than the difference at lower frquencies.

Relation B-pb level as an exposure parameter and effect parameters

	r	P - Value
Age	0.2875	< 0.001
duration of exposure	0.9120	< 0.001
HTL		
500 Hz	0.7471	< 0.001
1000Hz	0.7148	< 0.001
2000 Hz	0.7029	< 0.001
4000 Hz	0.7347	< 0.001
8000 Hz	0.7426	< 0.001

Table (8): In this table, there is +ve significant correlation between B-pb level and HTL at 500, 1000, 2000, 4000 and 8000Hz i.e as blood lead increases the HTL increases and also there is +ve significant correlation between B-pb level , age, and duration of exposure.

Variation of cases with prolonged IPLP from (I-V), from those without prolongation of IPLP (I-V)

(no = 50 randomly selected from the 500 exposed workers)

Variable	Group with prolonged IPLP (I-V) (no =4) Mean ± SD	Group without prolonged IPLP (I-V) (no=46) Mean ± SD	U-	P-Value
Age	47.25 ± 3.77	38.36 ± 6.9	4.00	<0.01
Duration of exposure	19. 50 ± 5.32	14.56 ± 4.00	36.5	<0.05
HTL:				
at 500Hz	10.00 ± 0.00	8.58 ± 2.27	66.0	>0.05
at 1000 Hz	20.00 ± 0.00	15.97 ± 5.63	56.0	>0.05
at 2000 Hz	31.25 ±2.50	24.56 ± 10.68	67.0	>0.05
at 4000 Hz	36.25 ± 2.50	26.95 ± 11.52	39.0	< 0.05
at 8000Hz	37.50 ± 2.88	29.45 ± 12.21	60.0	>0.05
B-pb	66.25 ± 4.78	39.04 ± 11.17	6.0	<0.001
EPP	135.75 ± 49.25	62.10 ± 34.14	7.0	<0.001

Table (9): In this table, the group of exposed workers with prolonged IPLP (I-V) differed significantly from the group without prolonged IPLP (I-V) in age, duration of exposure, B-pb level, EPP and HTL at 4000Hz

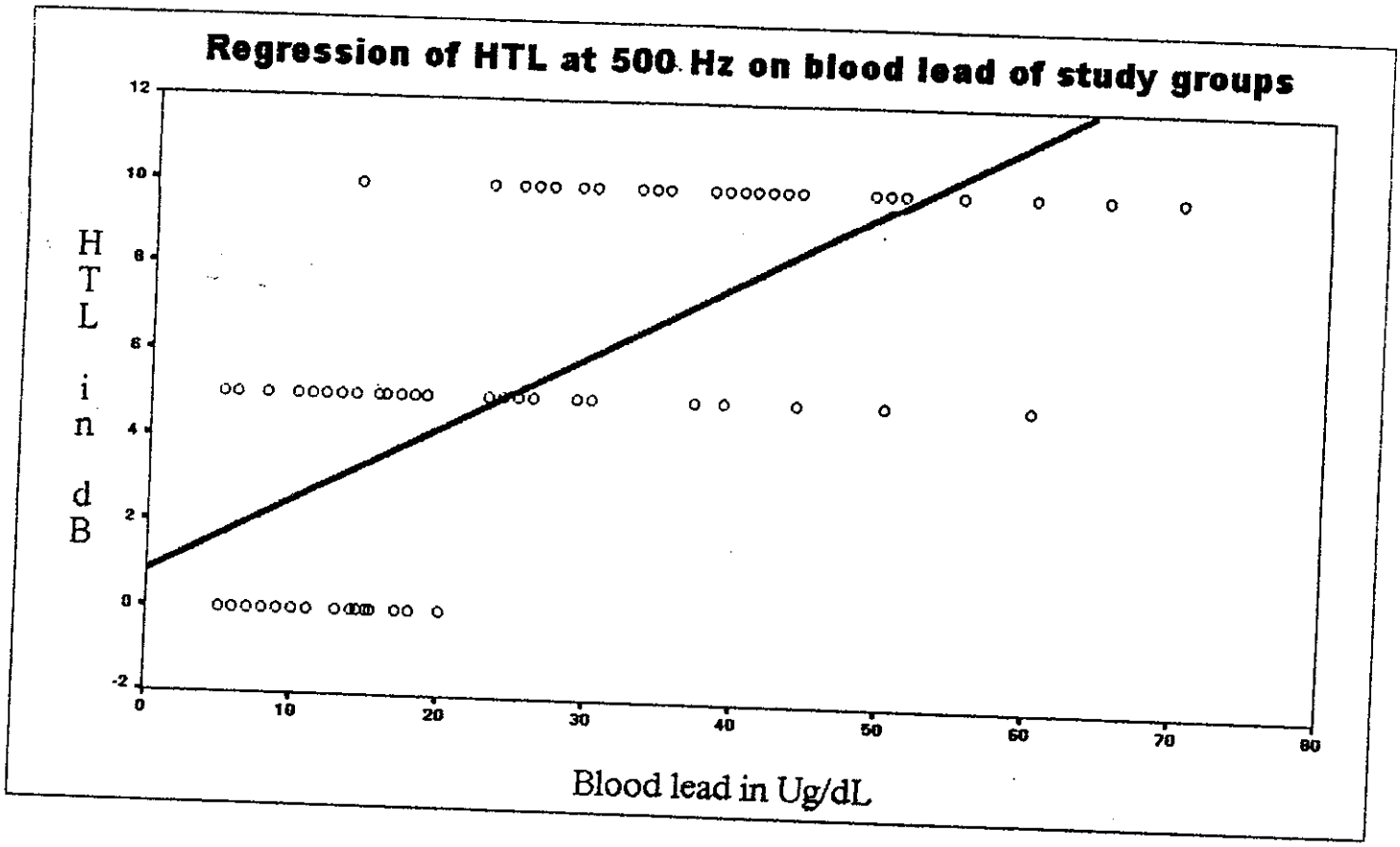


Fig (1): B-pb and HTL at 500Hz for the studied groups (no = 1000)

$Y = 0.837 + 0.174\ x + 0.004$

$r = 0.747$, $r^2 = 0.558$, $P<0.001$

Exposed : in the upper half

Controls : in the lower half

This regression figure shows that HTL changes with B-pb level i.e any rise of B-pb leads to impairment of hearing

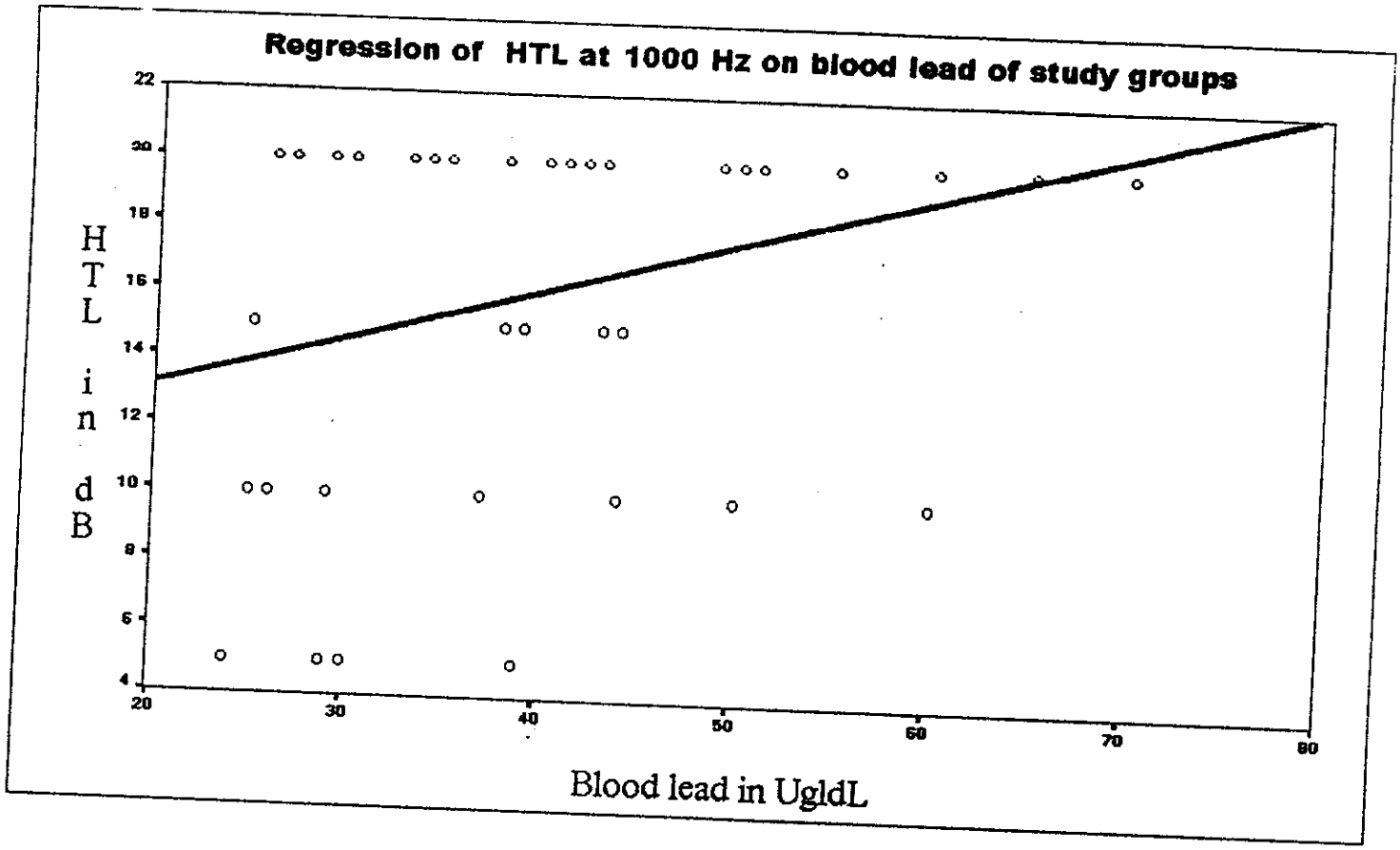


Fig (2) : B-pb and HTL at 1000 Hz for the studied groups (no=1000)

$Y = 0.930 + 0.262\ x + 0.008$

$r = 0.714$, $r^2 = 0.511$, $P<0.001$

Exposed : in the upper half

Controls : in the lower half

This regression figure shows that HTL changes with B-pb level i.e any rise of B-pb leads to impairement of hearing.

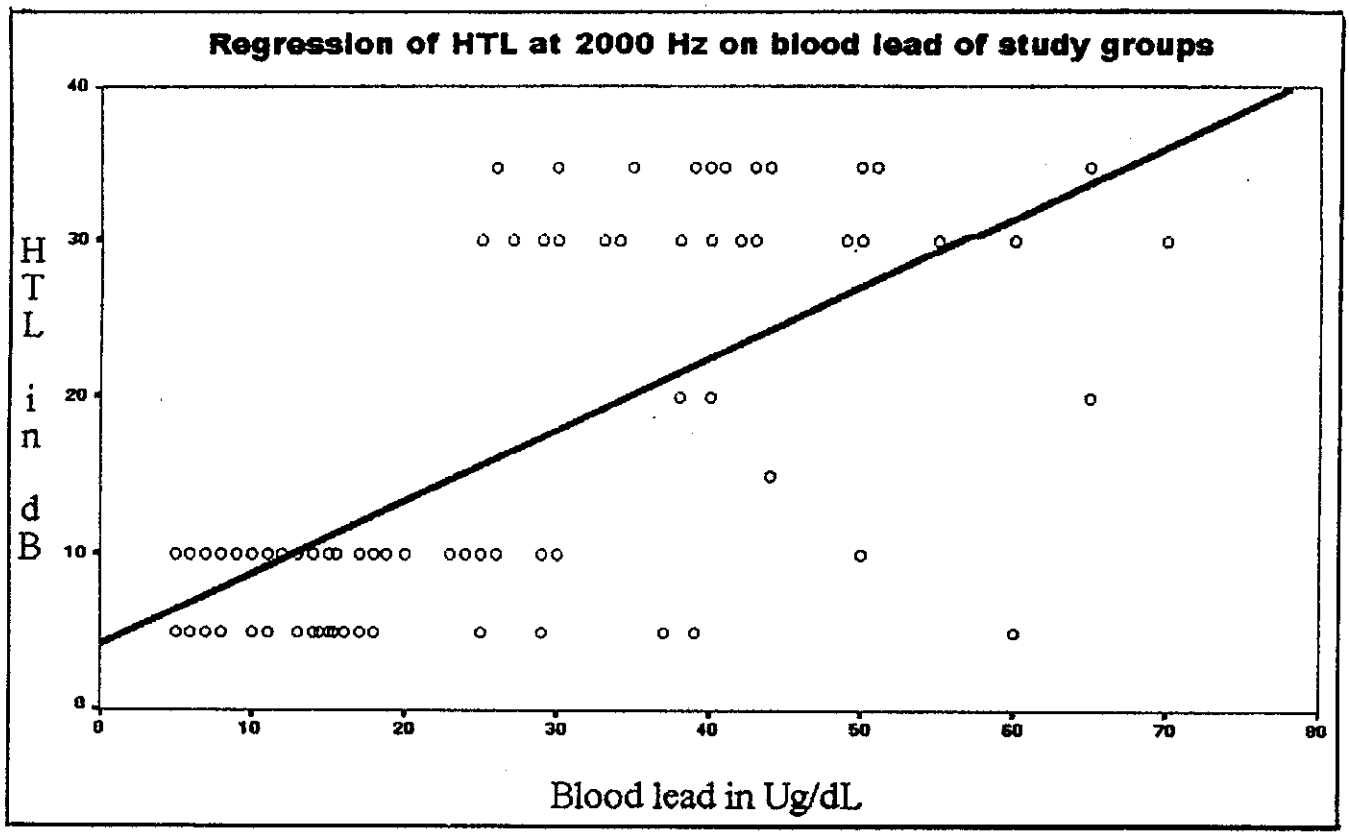


Fig (3) : B-pb and HTL at 2000 Hz for the studied group (no=1000)

$Y = 4.257 + 0.456\,x + 0.014$

$r = 0.702$, $r^2 = 0.494$, $P<0.001$.

Exposed : in the upper half.

Controls : in the lower half

This regression figure shows that HTL changes with B-pb level i.e any rise of B-pb leads to impairement of hearing.

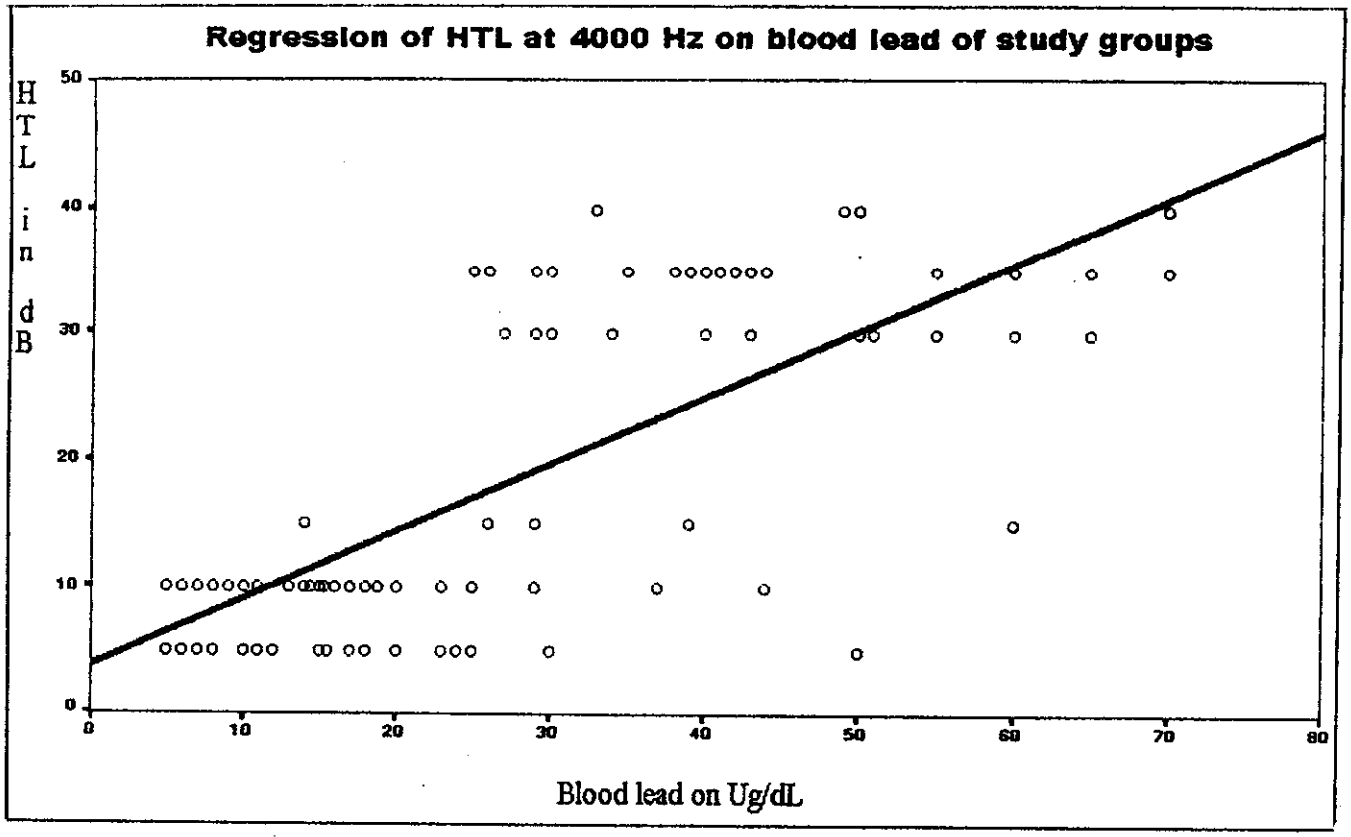


Fig (4) : B-pb and HTL at 4000 Hz (no = 1000)

Y= 3.852 + 0.528 *x* + 0.015

r= 0.734 , r^2= 0.539 , P<0.001

Exposed : in the upper half

Controls : in the lower half

This regression figure shows that HTL changes with B-pb level i.e any rise of B-pb leads to impairment of hearing

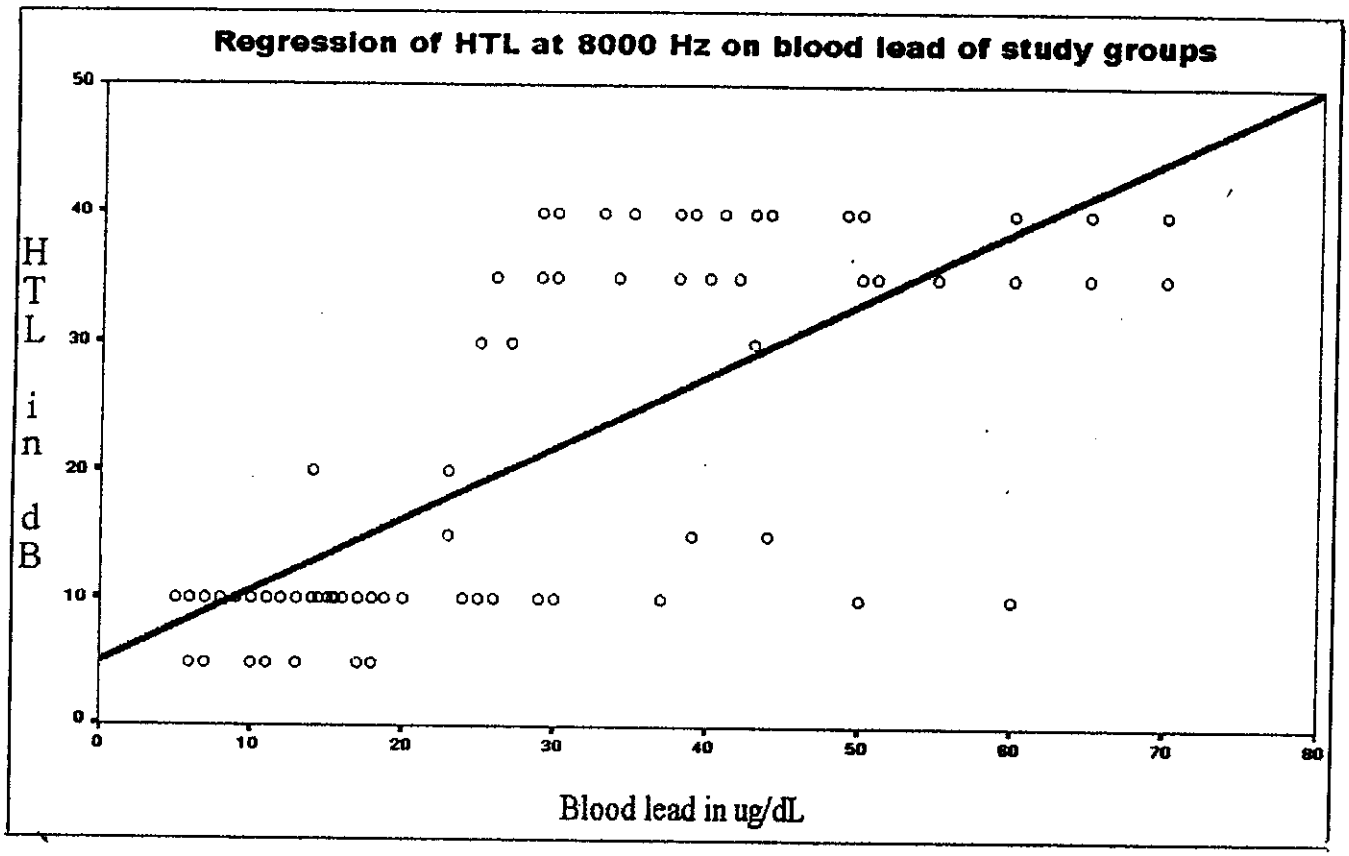


Fig (5) : B-pb and HTL at 8000Hz (no= 1000)

Y = 5.095 + 0.559 x + 0.015

r= 0.742 , r^2= 0.551 , P<0.001

Exposed : in the upper half

Controls : in the lower half

This regression figure shows that HTL changes with B-pb level i.e any rise of blood lead levels leads to impairment of hearing.

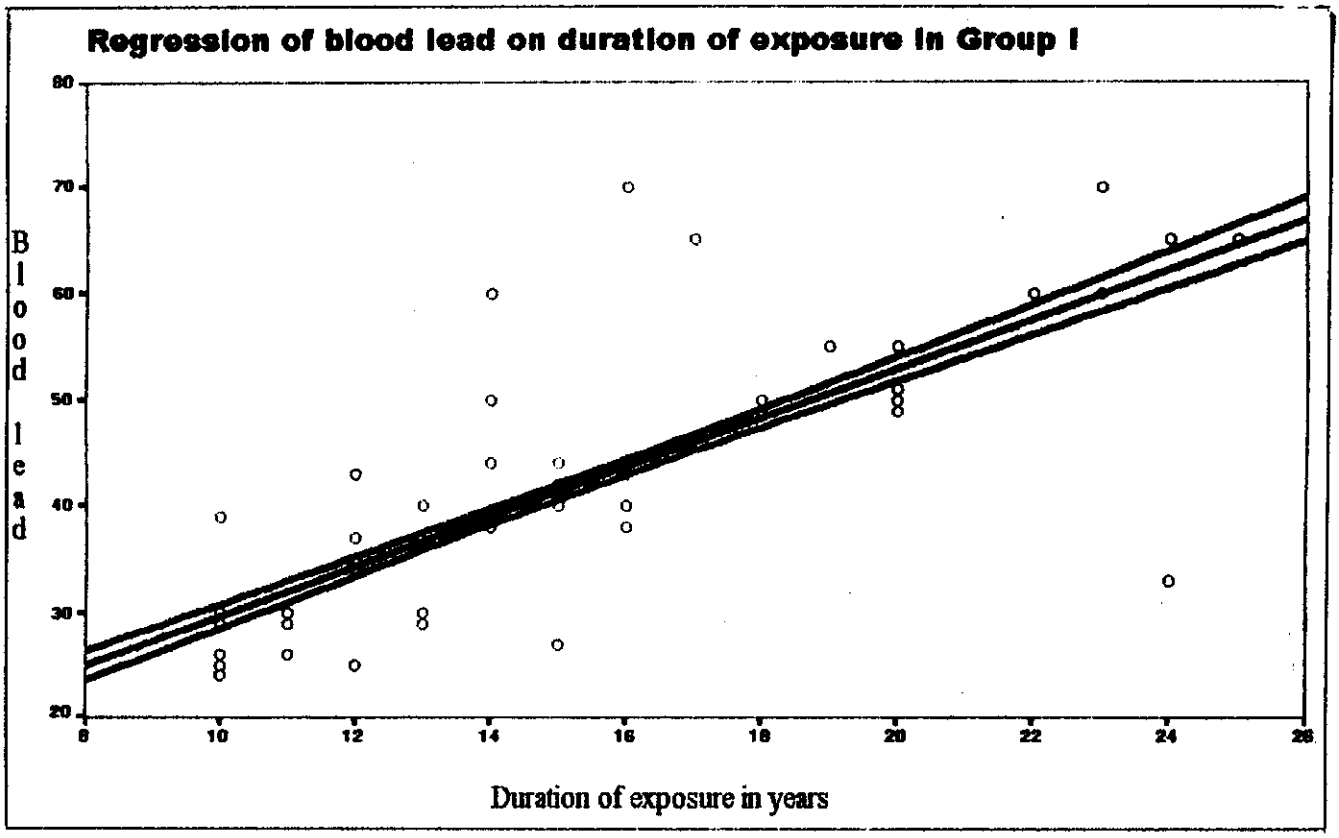


Fig (6): B-pb and duration of exposure (no = 500)

$Y = 6.358 + 2.330\,x + 0.088.$

$r = 0.761$, $r^2 = 0.579$, $P<0.001$

This regression figure shows that B-pb changes with duration of exposure i.e any rise of duration of exposure leads to rise of B-pb

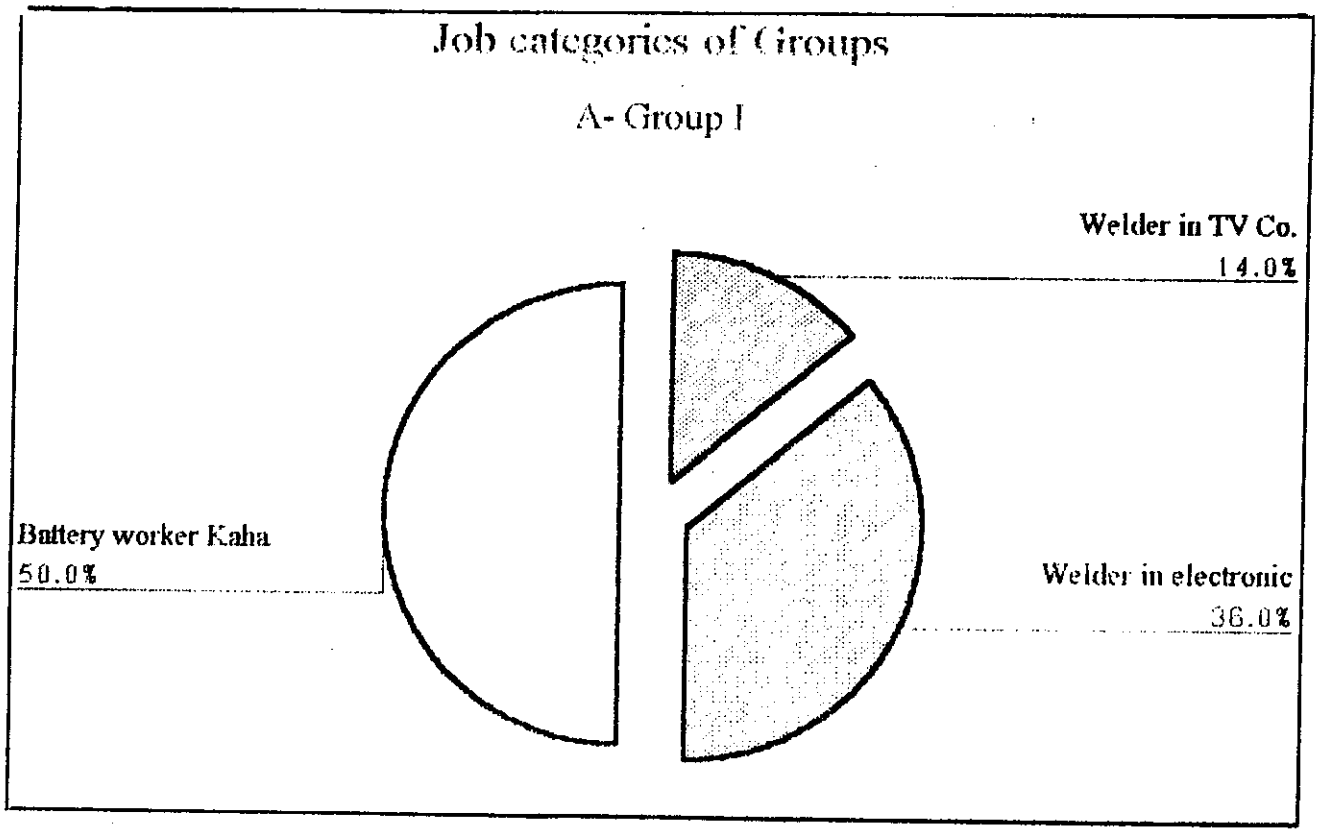


Fig (7): shows Job categories of group(I)

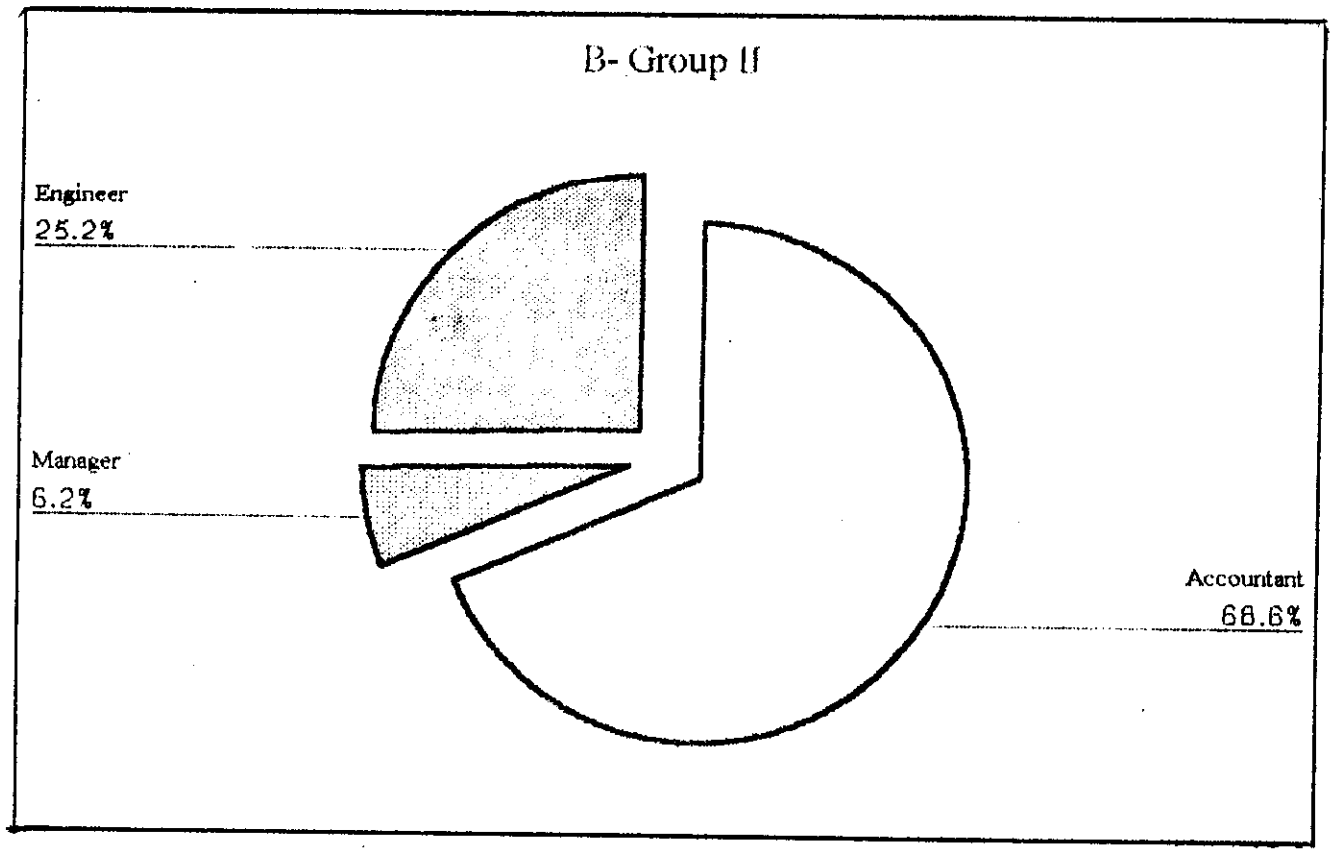


Fig (8): shows Job categories of group (II)

The Results Of The Experimental Study :

Our experimental study was conducted on 30 guinea pigs, divided in three groups. The lrt group consisted of 10 guinea pigs as control group, the 2nd and 3rd groups each of them consisted of 10 guinea pigs, they were injected I.P. by 1% water solution of lead acetate at concentrations 0 mg, 10 mg and 20 mg respectively once a week for 5 consecutive weeks, then they were sacrified and the cochleae of them were examined histologically by both light microscopy and electron microscopy to show the effect of lead toxicity on the cochlea.

The results obtained by light microscopy :

Group (I) showed:

a) Normal outer and inner hair cells, Fig: (9), (10)

b) Normal basilar membrane and spiral ligament, Fig : (9),(10)

c) Normal spiral ganglion with nerve cells and nerve fibres. Fig: (15) , (16) ,(17)

Group (II) showed:

a- Normal inner and outer hair cells of the organ of Corti Fig: (11), (12)

b- Normal basilar membrane and spiral ligament Fig: (11),(12)

c- Moderate degeneration of the spiral ganglion showed both normal and degenerated nerve fibres. Fig (18), (19), (20)

Group (III) showed:

a- Normal inner and outer hair cells. Fig: (13), (14)

b- Normal basilar membrane and spiral ligament. Fig:(13),(14)

c- Severe degenerating nerve fibres. Fig: (21) , (22)

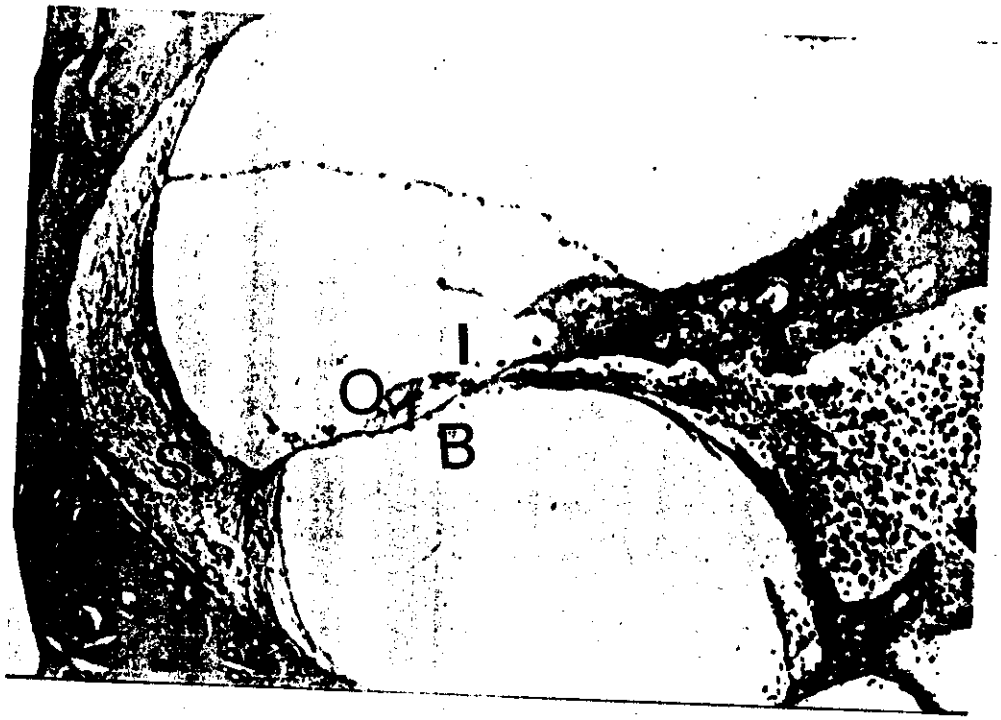


Fig (9): A photomicrograph of the cochlea of the 1rt group shows, normal (0) outer hair cells, normal (I) inner hair cells of the organ of Corti, normal (S) spiral ligament, normal (b) basilar membrane and normal (g) spiral ganglion.

(Stained with hematoxylin & eosin x 100).

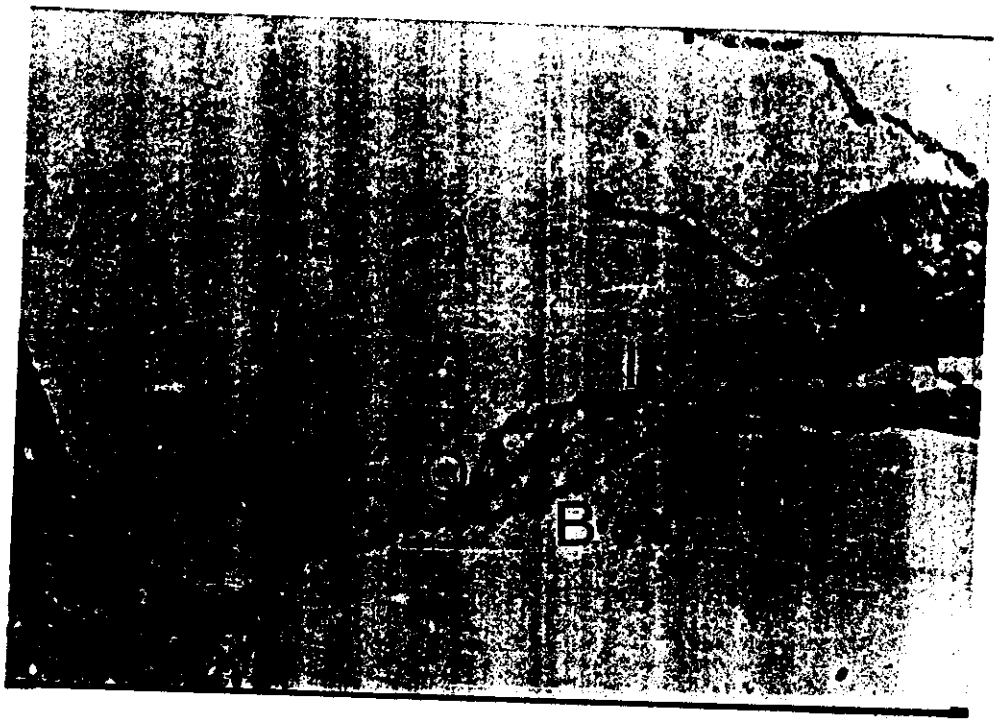


Fig (10): A photomicrograph of the cochlea of the 1rt group shows , normal (0)outer hair cells , normal (I) inner hair cells, normal (S) spiral ligament and normal (b) basilar membrane. (Stained with hematoxylin & eosin x 200).

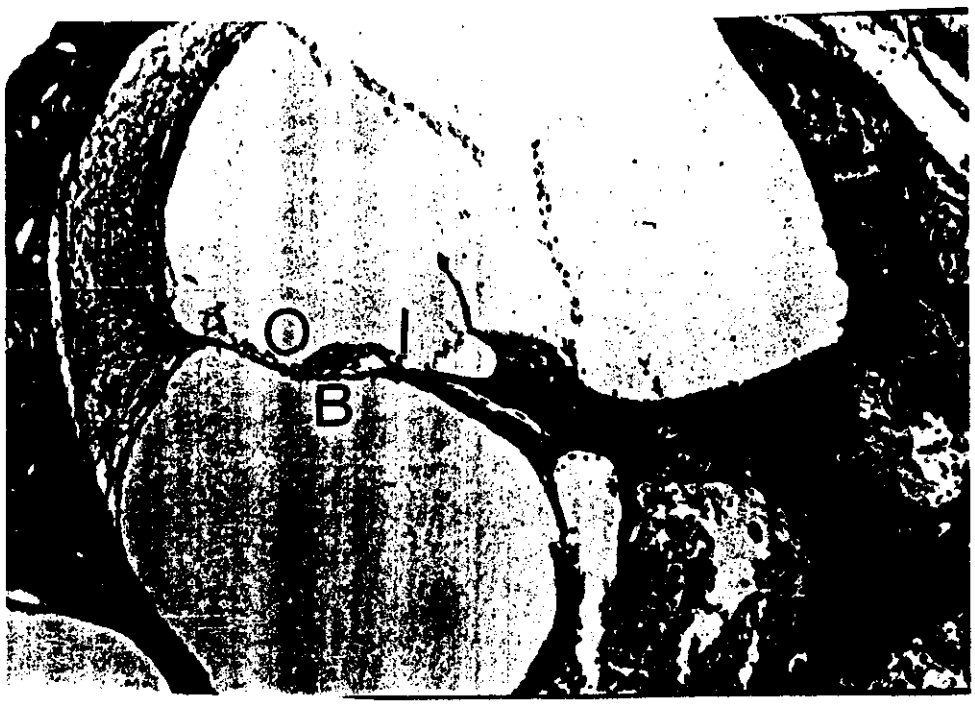


Fig (11): A photomicrograph of the cochlea of the 2 nd group shows, normal (0) outer hair cells , normal (I) inner hair cells, normal (S) spiral ligament and (b) basilar membrane, (g) spiral ganglion with nerve cells and nerve fibres.
(Stained with hematoxylin & eosin x 100)

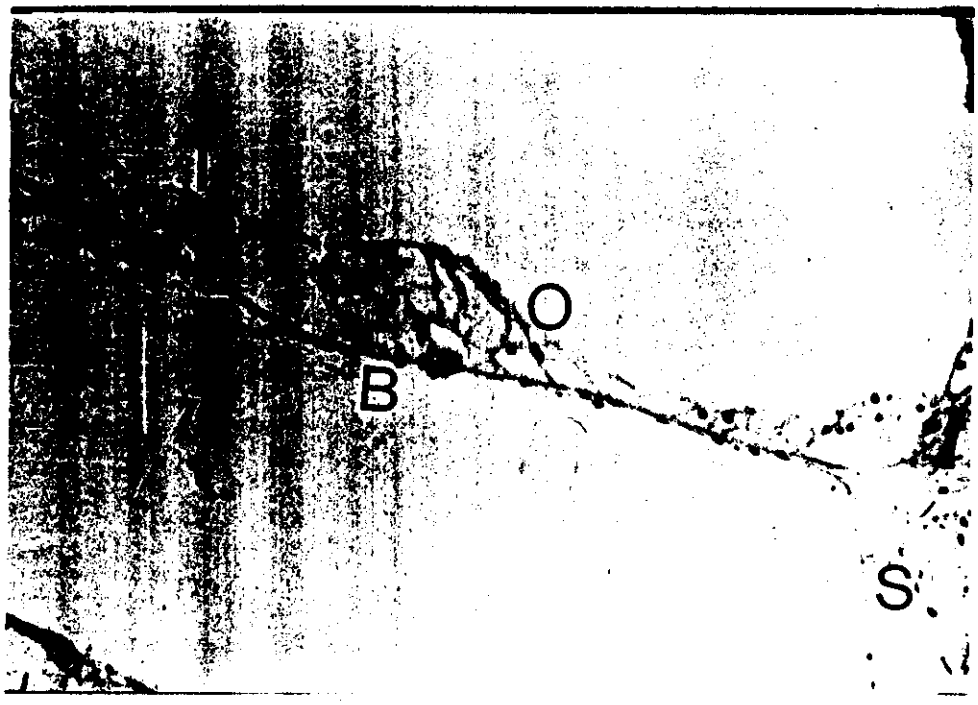


Fig (12): A photomicrograph of the cochlea of the 2nd group shows, normal (0) outer hair cells, normal (I) inner hair cells, normal (b) basilar membrane and normal (S) spiral ligament.

(Stained with hematoxylin & eosin x 200)

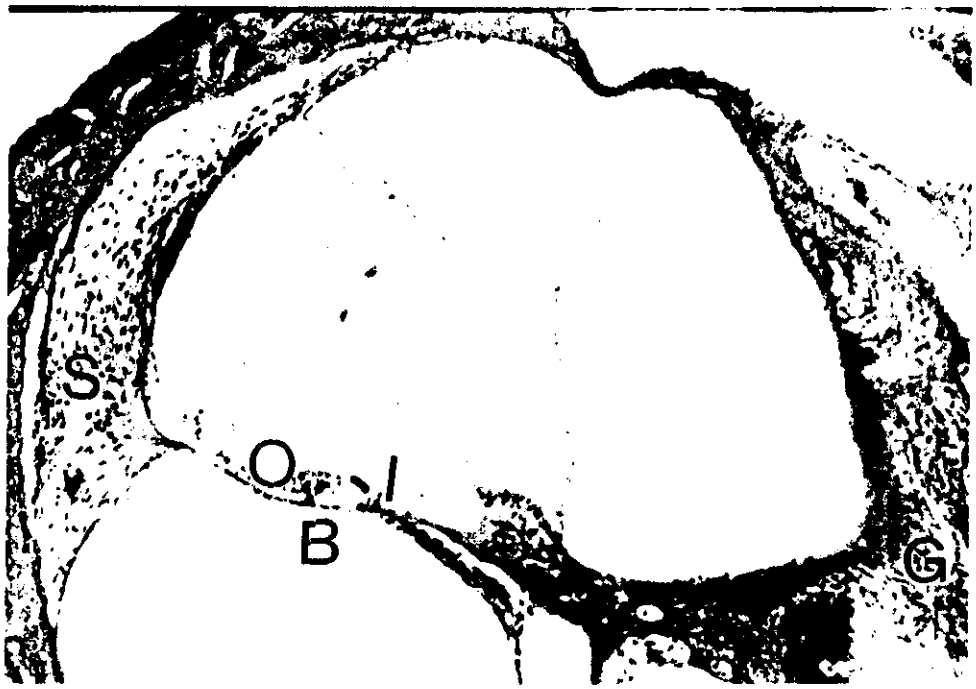


Fig (13): A photomicrograph of the cochlea of the 3rd group shows, normal (0) outer hair cells, normal (I) inner hair cells normal (b) basilar membrane, normal (S) spiral ligament and (g) spiral ganglion with nerve cells and fibres (Stained with hematoxylin & eosin x 100).

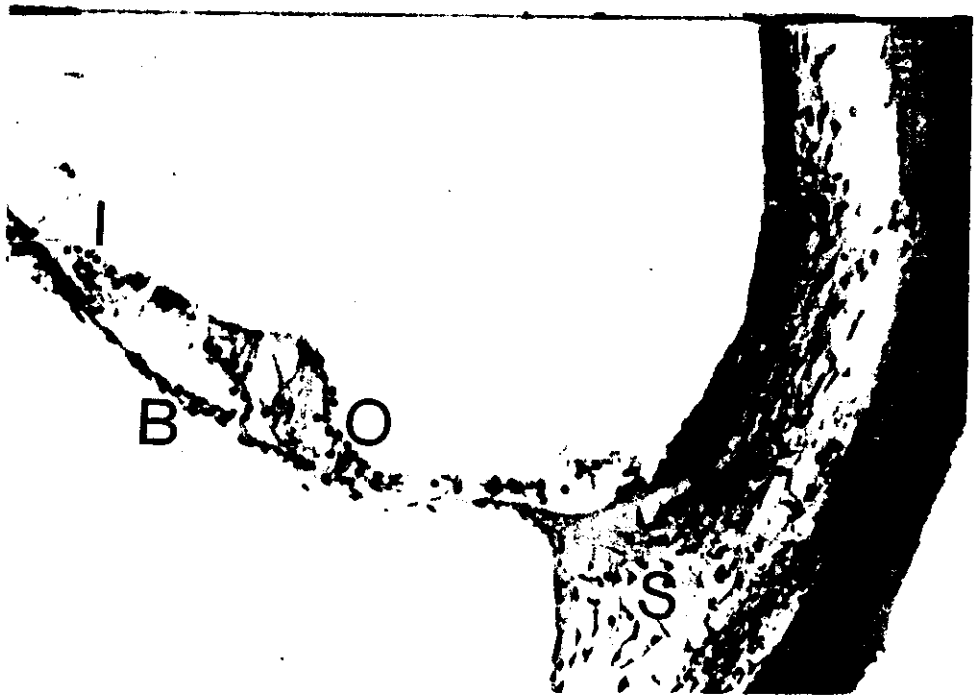


Fig (14): A photomicrograph of the cochlea of the 3rd group shows, normal (0) outer hair cells, normal (I) inner hair cells, normal (b) basilar membrane, normal (S) spiral ligament . (Stained with hematoxylin & eosin x 200).

Fig (15): A photomicrograph of the cochlea of the 1rt group shows, normal spiral ganglion (g) with normal nerve fibres (f) and nerve cells (C) (Stained with silver x 100).

Fig (16): A photomicrograph of the cochlea of the 1rt group shows, spiral ganglion (g) with normal nerve fibres (f) and nerve cells (C). (Stained with silver x 200)

Fig (17): A photomicrograph of the cochlea of the 1rt group shows, normal spiral ganglion (g), normal nerve cells (C) and nerve fibres (f) (Stained with silver x 400)

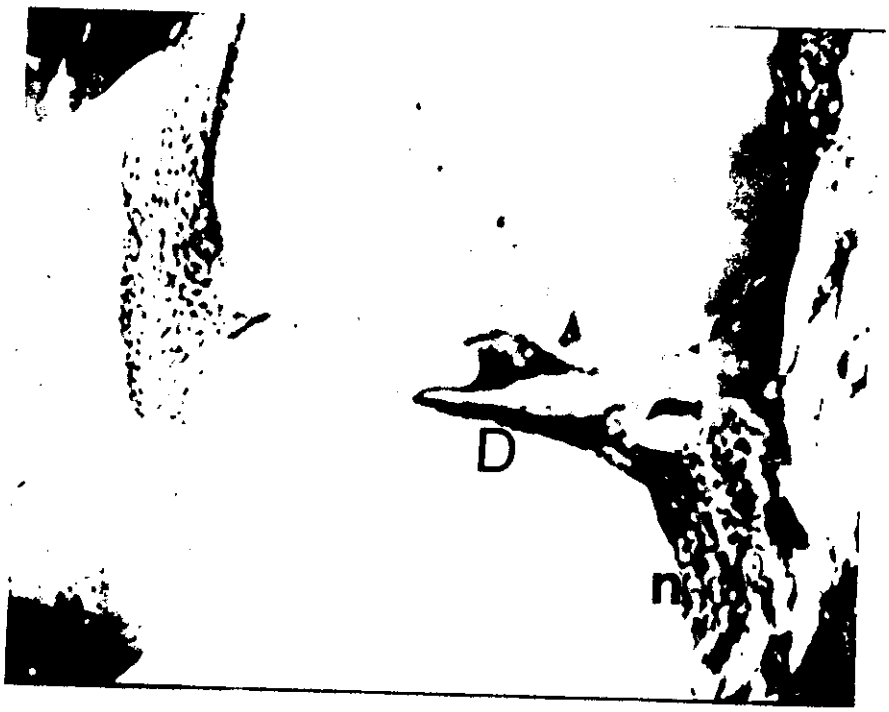


Fig (18): A photomicrograph of the cochlea of the 2nd group shows moderate degenerating nerve fibres, both normal (n) and degenerating (d) nerve fibres demonstrated in this figure (Stained with silver x 100).

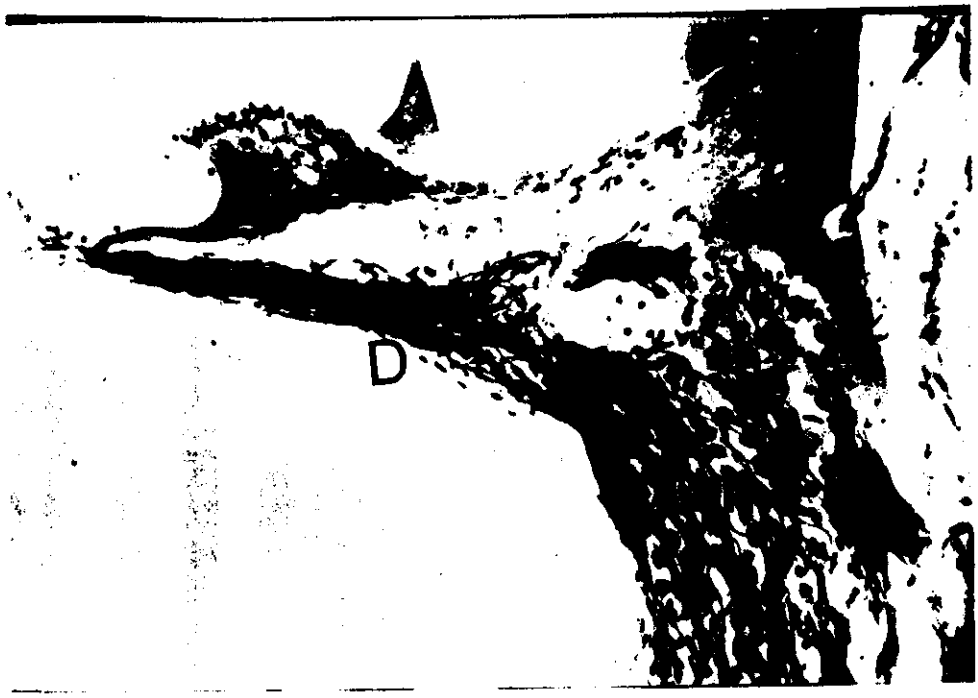


Fig (19): A photomicrograph of the cochlea of the 2nd group shows, moderate degenerating nerve fibres, both normal fibres (n) and degenerating fibres (d) demonstrated in this figure . (Stained with silver x 200)

Fig (20): A photomicrograph of the cochlea of the 2nd group shows, moderate degenerating nerve fibres, both normal fibres (n) and degenerating fibres (d)demonstrated in this figure. (Stained with silver x 400)

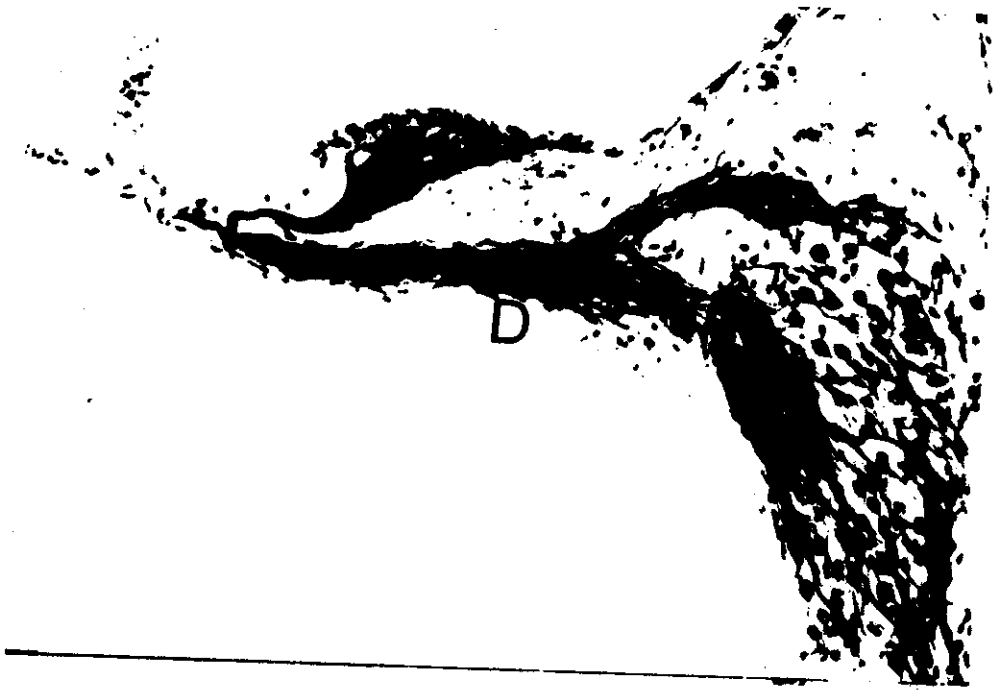


Fig (21): A photomicrograph of the cochlea of the 3rd group shows, the spiral ganglion with severe degenerating nerve fibres (d). (Stained with silver x 200) .

Fig (22): A photomicrograph of the cochlea of the the 3rd group shows, the spiral ganglion with severe degenerating nerve fibres (d) . (Stained with silver x 400).

The results obtained by electron microscopy :

Group (I) showed :

Normal nerve fibres with intact myelin sheath, the axoplasm contains intact neurofilaments and neurotubules, Fig:(23)

Group (II) showed:

Nerve fibres with disruption and disorganization of myelin sheath with normal axoplasm, Fig: (24). Other fibres showed complete absence of myelin sheath and some fibres showed normal myelin sheath and vacuolization of the axoplasm with degeneration of neurofilaments and neurotubules, Fig : (25) , (26), (27).

Group (III) showed:

Nerve fibres with compined degeneration of myelin sheath and axoplasm. The nerve fibres became segmented and granular , Fig:(28) , (29).

Fig (23): Transmission electron micrograph of the cochlear nerve fibres of the 1rt group shows, thick intact myelin sheath (m), normal axoplasm (a) and schwann cells (s).
(Tansmission electron micrograph x 15000)

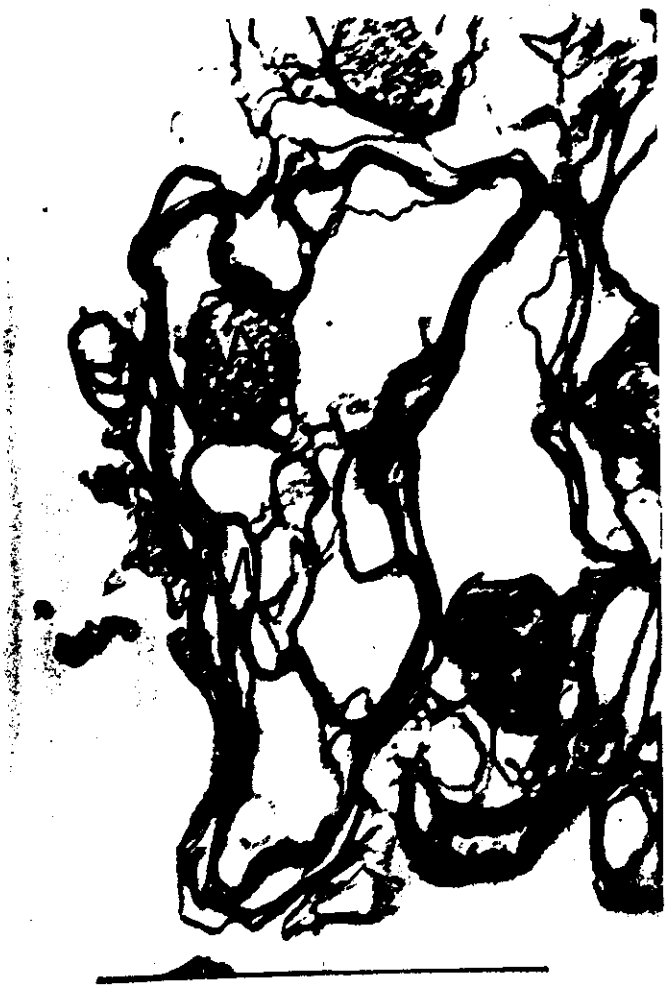


Fig (24): Transmission electron micrograph of the cochlear nerve fibres of the 2nd group shows, disruption and disorganization of myelin sheath (m), with normal neurofilaments and neurotubules of axoplasm (a),

(Transmission electron micrograph x 15000)

Fig (25): Transmission electron micrograph of cochlear nerve fibres of the 2nd group shows, thin degenerated myelin sheath (d) with vacuolated cytoplasm(V) and separation of layers of myelin sheath (S)

(Tansmission electron micrograph x 15000)

Fig (26) : Transmission electron micrograph of cochlear nerve fibres of the 2nd group shows, combined degenerated myelin sheath (m) with vacuolated cytoplasm (V)
(Transmission electron micrograph x 30000)

Fig (27): Transmission electron micrograph of cochlear nerve fibres of the 2nd group shows, myelinated nerve fibres (m) with axonal degeneration (d).

(Transmission electron micrograph x 15000)

Fig(29): Transmission electron micrograph of cochlear nerve fibres of the 3rd group shows, disruption of myelin sheeth which became segmented (s) and granular (g) with axonal degeneration (a)

(Transmission electron micrograph x 15000)