RESULTS

RESULTS

First group (control group)

A) Liver study:

Light microscope observations

H&E stain: showed sheets or cords of hepatocytes radiating from a central vein; each a single cell thick, which bifurcated and fused to give a network (Fig. 5). Hepatocytes were approximately cuboidal in shape with acidophilic cytoplasm and central basophilic nuclei. Some cells showed 2 nuclei. Blood sinusoids were present between the cords of hepatocytes and within the sinusoids some Kupffer cells were present (Fig. 6).

Masson's trichrome stain: The liver showed no collagen fibers around the central vein (Fig. 7) with minute amount of collagen fibers in the portal tract (Fig. 8).

Toluidine blue stain (semithin section): showed cords of normal hepatocytes . Every hepatocyte showed a central nucleus with clearly apparent nucleolus. Blood sinusoids were present between the cords of hepatocytes and contained a column of RBCs and some Kupffer cells (Fig. 9). Ito cells appeared with vitamin A droplets in their cytoplasm (Fig. 10).

Fig. (5) A photomicrograph of a section in liver obtained from an adult male rat of first group showing cords of normal hepatocytes radiating from a central vein.

[H&E stain., Proj. 10X, Obj. 10X]

Fig. (6) A photomicrograph of a section in liver obtained from an adult male rat of first group showing blood sinusoid between the cords of hepatocytes and within the sinusoids some Kupffer cells (arrows).

[H&E stain., Proj. 10X, Obj. 40 X]

Fig. (7) A photomicrograph of a section in liver obtained from an adult male rat of first group showing no collagen fiber accumulation around the central vein.

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (8) A photomicrograph of a section in liver obtained from an adult male rat of first group showing minute amount of collagen fibers in the portal tract.

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (9) A photomicrograph of a semithin section in liver obtained from an adult male rat of first group showing cords of normal hepatocytes. Nuclei appear nearly central with obvious nucleolus (N). The blood sinusoid contains RBCs and Kupffer cells (arrows).

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

Fig. (10) A photomicrograph of a semithin section in liver obtained from an adult male rat of first group showing Ito cells with vitamin A droplets in their cytoplasm (arrows).

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

E/M observations

The cytoplasm of hepatocytes contained numerous mitochondria, rER, Golgi complexes, small fat droplets and secretory granules (Fig. 11). The blood sinusoid contained RBCs and kupffer cells while Ito cell that contained many vitamin A droplets was present outside its wall.

B) Bone marrow study

Chromosomal study:

The chromosomal pattern of albino rat samples prepared from bone marrow of an adult male control animal revealed that the chromosomal complement of rat consisted of 42 chromosomes (Fig. 12). The chromosomal anomalies were within the range of 2 - 4% and the anomalies encountered were in the form of deletion (Fig. 13), end to end association (Fig. 14), gap (Fig.15), hypodiploidy (Fig. 16) and hyperdiploidy (Fig. 17).

Transformed cells:

The transformed lymphocyte cell appeared large with pale nucleus and apparent nucleolus. The cytoplasm was abundant around the nucleus (Fig. 18)

The average percentage of the transformed cells was within the range of 20% to 24% (Histogram 1 and 6).

Fig. (11) An electron micrograph of liver section obtained from an adult male rat of first group showing a hepatocyte containing numerous mitochondria, rER, Golgi complexes, small fat droplets and secretory granules. The blood sinusoid contains RBCs and Kupffer cells while Ito is cell appears outside its wall (arrows).

[Uranyl acetate-Lead citrate, 3000 X.]

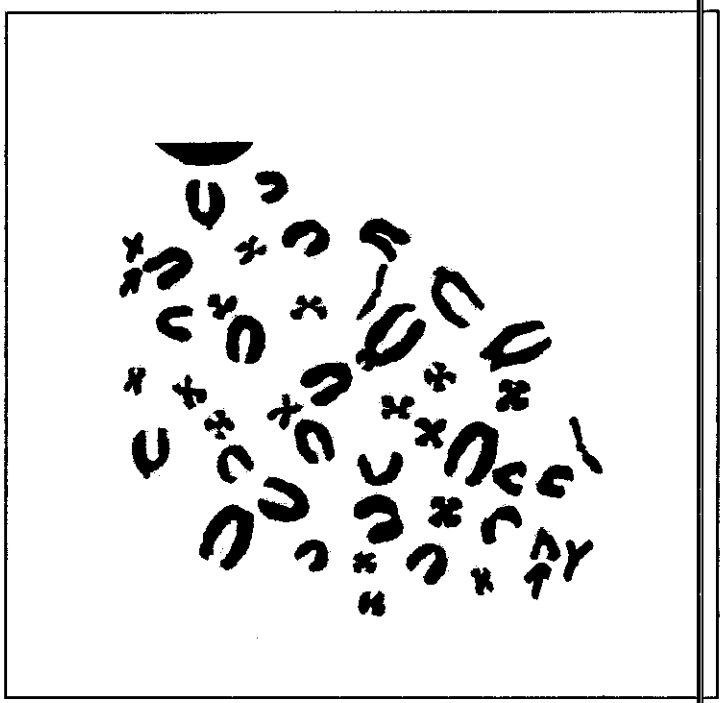


Fig. (12) A photomicrograph of metaphase spread of normal bone marrow chromosomes of male control rat. Note that the complement contains an X and Y chromosomes (arrows).

[Giemsa stain., Proj. 10X. Obj. 100X]

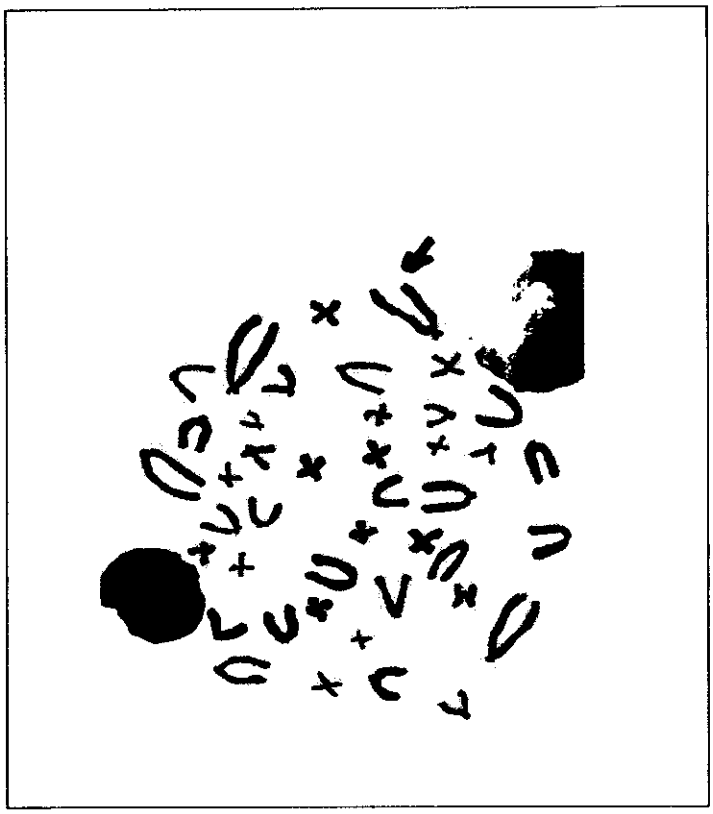


Fig. (13) A photomicrograph of a metaphase spread of bone marrow chromosomes of male control rat showing deletion (arrow)

[Giemsa stain., Proj. 10X. Obj. 100X]

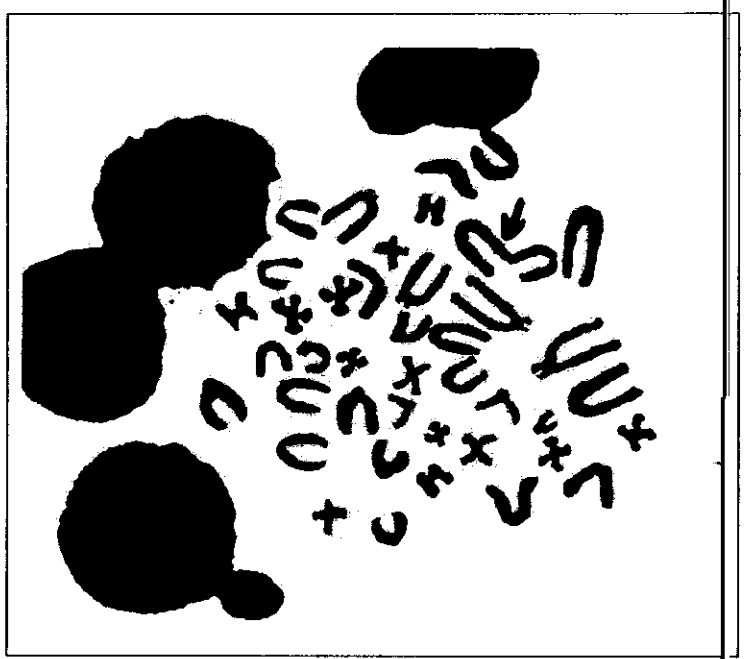


Fig. (14) A photomicrograph of a metaphase spread of bone marrow chromosomes of male control rat showing end to end association (arrow).

[Giemsa stain., Proj. 10X. Obj. 100X]

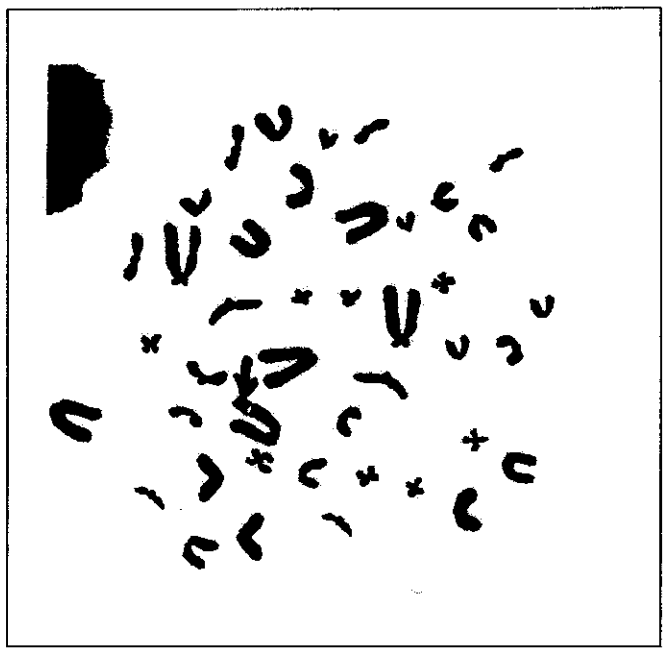


Fig. (15) A photomicrograph of a metaphase spread of bone marrow chromosomes of male control rat showing gap (arrow)

[Giemsa stain., Proj. 10X. Obj. 100X]

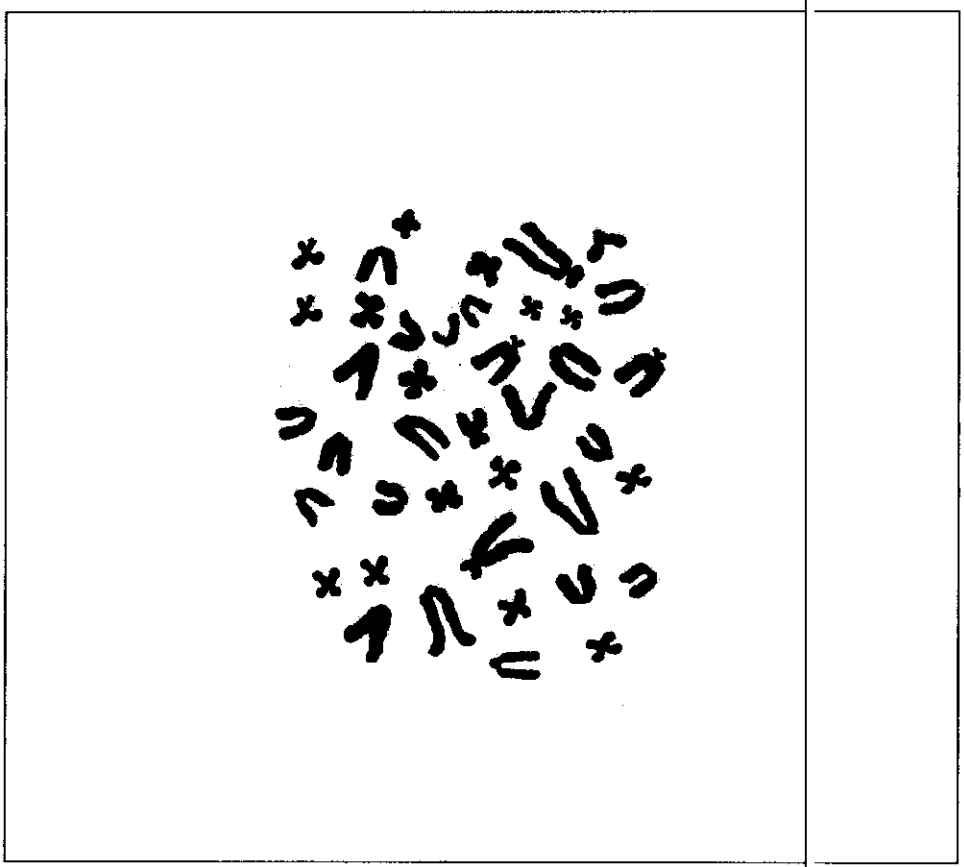


Fig. (16) A photomicrograph of a metaphase spread of bone marrow chromosomes of male control rat showing hypodiploidy (41 chromosomes).

[Giemsa stain., Proj. 10X. Obj. 100X]

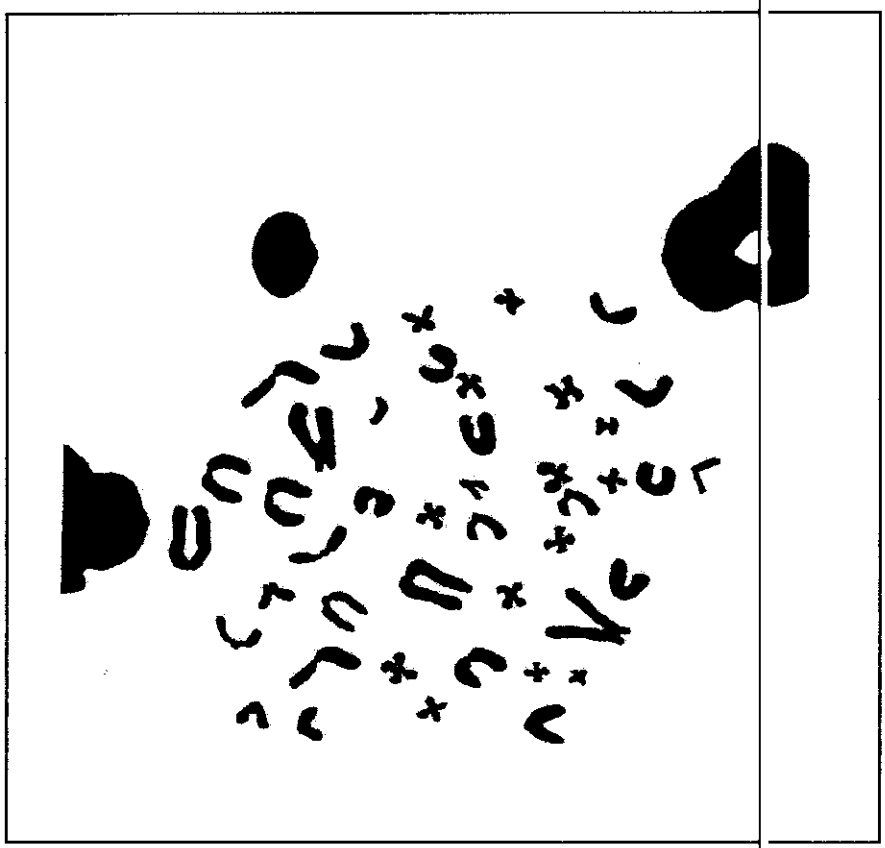
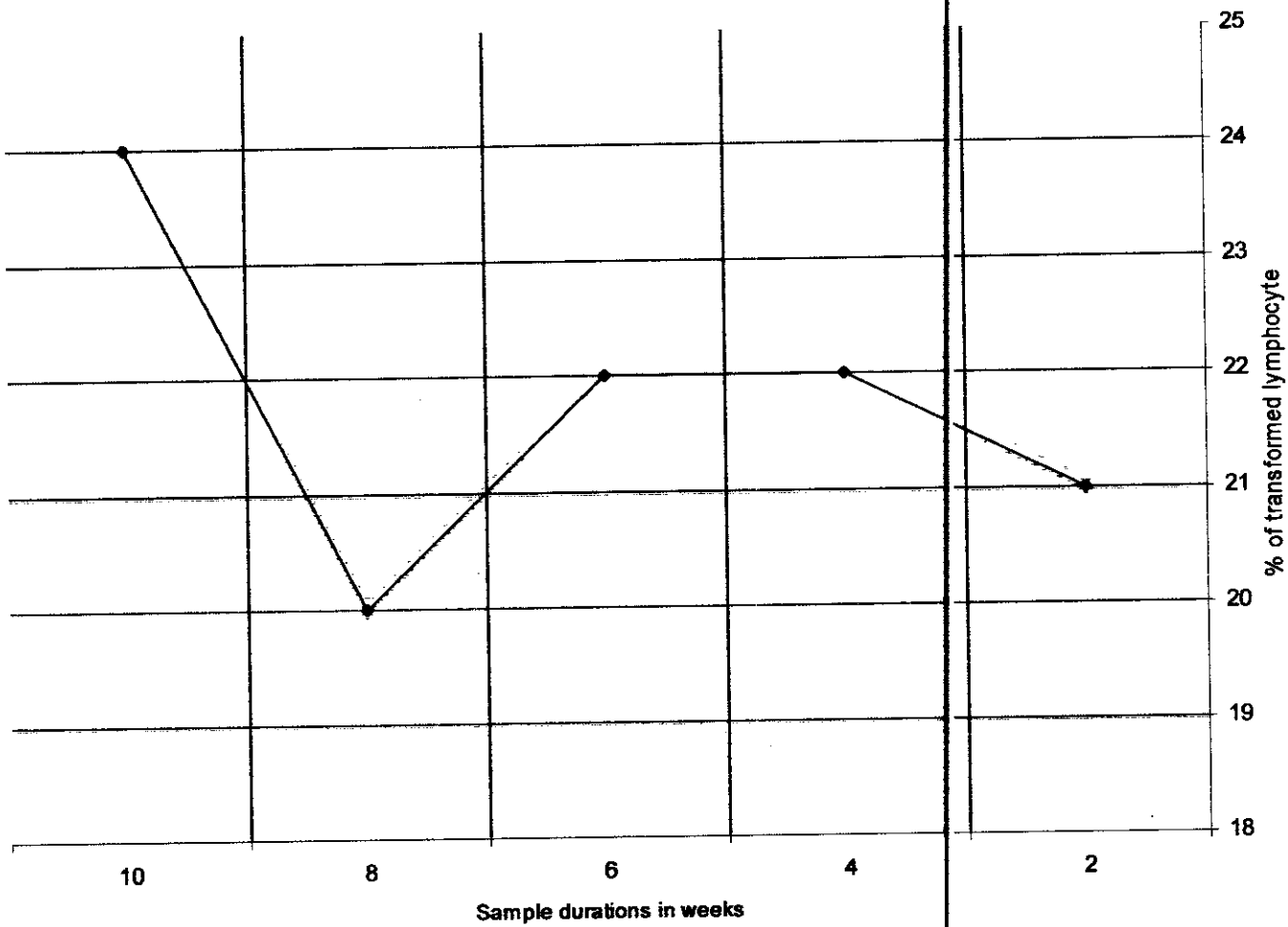


Fig. (17) A photomicrograph of a metaphase spread of bone marrow chromosomes of male control rat showing hyperdiploidy (43 chromosomes).

[Giemsa stain., Proj. 10X. Obj. 100X]

Fig. (18) A photomicrograph of bone marrow smear of male control rat showing transformed lymphocytes (arrows).
[Giemsa stain., Proj. 10X. Obj. 100X]

Histogram (1) showing the % of the transformed lymphocytes in different sample durations in the first group (control group)



Second group (positive control group)

A) Liver study:

Light microscope observations

H&E stain: The hepatocytes showed mild ballooning at the midzonal region in the 2 weeks sample (Fig. 19). By the 4th week, some hepatocytes showed disappearance of cytoplasmic contents (vacuolation) that became evident after 8 weeks (Fig.20). By the 10th week (2 weeks after stoppage of CCl_4), the hepatocytes regenerated and the normal hepatic lobule was resumed (Fig. 21).

Masson's trichrome stain: There was slight accumulation of collagen fibers after 2 weeks of CCl_4 ingestion that seen around the central vein (Fig. 22). By the 4th week, collagen fibers become slightly more obvious (Fig. 23). The collagen fibers accumulation increased until it becomes extensive to extend between hepatic cords at the 8th week (Fig. 24). By the 10th week (2 weeks after stoppage of CCl_4), the fibrosis decreased markedly (Fig. 25).

Toluidine blue stain (semithin section): The hepatocytes showed mild ballooning in the 2nd week sample (Fig. 26) and Ito cells were showing complete and mild evacuation of their content. Some cells appeared fully studded with vitamin A droplets (Fig. 27).

Fig. (19) A photomicrograph of a section in liver obtained from an adult male rat of second group after 12 weeks of administration of CCl_4 showing mild ballooning of hepatocytes.

[H&E stain., Proj. 10X, Obj. 40X]

Fig. (20) A photomicrograph of a section in liver obtained from an adult male rat of second group after 8 weeks of administration of CCl_4 showing marked vacuolation of hepatocytes.

[H&E stain., Proj. 10X, Obj. 40X]

Fig. (21) A photomicrograph of a section in liver obtained from an adult male rat of second group 2 weeks after stoppage of CCl_4 administration showing normal hepatic lobules.
[H&E stain., Proj. 10X, Obj. 40X]

Fig. (22) A photomicrograph of a section in liver obtained from an adult male rat of second group after 2 weeks of administration of CCl_4 showing slight accumulation of collagen fibers around the central vein.
[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (23) A photomicrograph of a section in liver obtained from an adult male rat of second group after 4 weeks of administration of CCl_4 showing more accumulation of collagen fibers around the central vein.

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (24) A photomicrograph of a section in liver obtained from an adult male rat of second group after 8 weeks of administration of CCl_4 showing extensive accumulation of collagen fibers that extended between hepatocyte cords .

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (25) A photomicrograph of a section in liver obtained from an adult male rat of second group 2 weeks after stoppage of CCL_4 administration showing slight accumulation of collagen fibers around the central vein.

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (26) A photomicrograph of a semithin section in liver obtained from an adult male rat of second group after 2 weeks of administration of CCl_4 showing mild ballooning of hepatocytes.

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

Fig. (27) A photomicrograph of a semithin section in liver obtained from an adult male rat of second group after 2 weeks of administration of CCl_4 showing complete and mild evacuation of the Ito cells. Some cells appeared studded with vitamin A droplets (arrows).

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

The ballooning increased until it became marked with areas of cytoplasmic damage in the 8th week sample (Fig. 28). By the 10th week, the hepatocytes returned to near normal state and Ito cells appeared dimorphic; i.e, some appeared studded with vitamin A droplets and some appeared with evacuated cytoplasm (Fig. 29).

E/M observations

Mitochondria were swollen, rounded and showed partial destruction and also the ER was partially destroyed in some areas in the hepatocytes after 2 weeks of ingestion of CCl_4 (Fig.30). Evacuated Ito cells (myofibroblast) increased (Fig. 31). The destruction of the cell organelles increased until complete destruction and absence of these organelles with increasing of fine fat droplets in the cytoplasm were observed by the 8th week. An Ito cell with several vitamin A droplets in its cytoplasm was also observed at the wall of the sinusoid (Fig. 32). By the 10th week, the hepatocytes returned to normal picture (Fig. 33).

B) Bone marrow study

Chromosomal study:

Chromosomal pattern and percentage of chromosomal anomalies were similar to that of first group (control group).

Fig. (28) A photomicrograph of a semithin section in liver obtained from an adult male rat of second group after 8 weeks of administration of CCl_4 showing severe ballooning of hepatocytes with areas of vaculation in cytoplasm.

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

Fig. (29) A photomicrograph of a semithin section in liver obtained from an adult male rat of second group after 2 weeks of stoppage of CCL_4 administration showing nearly normal hepatocytes. Some Ito cells appear studded with vitamin A droplets and others appear with evacuated cytoplasm (arrows).

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

Fig.(30) An electron micrograph of liver obtained from an adult male rat of second group after 2 weeks of administration of CCl_4 showing hepatocytes containing swollen mitochondria that show partial destruction and also destroyed ER in some areas.

[Uranyl acetate-Lead citrate, 4000 X.]

Fig.(31) An electron micrograph of liver obtained from an adult male rat of second group after 2 weeks of administration of CCl_4 showing evacuated Ito cell (arrow).

[Uranyl acetate-Lead citrate, 4000 X.]

Fig. (32) An electron micrograph of liver obtained from an adult male rat of second group after 8 weeks of administration of CCl_4 showing complete destruction and absence of cell organelles with increasing fine fat droplets in the cytoplasm. Ito cell containing several vitamin A droplets in its cytoplasm is also present (arrows).

[Uranyl acetate-Lead citrate, 3000 X.]

Fig. (33) An electron micrograph of liver obtained from an adult male rat of second group 2 weeks after stoppage of CCl_4 administration showing a normal hepatocyte with multiple mitochondria, ribosomes, ER and few Golgi complexes. The nucleus contains clearly apparent heterochromatin. An Ito cell with several vitamin A droplets in its cytoplasm appears at the wall of sinusoid

[Uranyl acetate-Lead citrate, 4500 X.]

Transformed cells:

The average percentage of the transformed cells was within the range of 16% to 20% (Histogram 2 and 6).

Third group (vitamin A group)

A) Liver study:

Light microscope observations

H&E stain:

Subgroup (a): (simulating second group) The hepatocytes showed mild ballooning in the 2 weeks sample that became evident after 8 weeks. By the 10^{th} week (2 weeks after stoppage of CCl_4), the normal hepatic lobule was resumed

Subgroup (b): Hepatocytes showed obvious vacuolation and ballooning in the 2 weeks sample (Fig. 34). By the 4^{th} week, there was marked ballooning and areas of necrosis appeared within the hepatic lobule (Fig. 35) that became extensive by the 8^{th} week (Fig.36). 2 weeks after stoppage of CCl_4, the areas of cell necrosis decreased but marked ballooning was still present (Fig. 37).

Masson's trichrome stain:

Subgroup (a): (simulating second group) There was slight accumulation of collagen fibers after 2 weeks of CCl_4 ingestion that increased until it becomes extensive. 2 weeks after stoppage of CCl_4, the fibrosis decreased markedly

Histogram (2) showing the % of transformed lymphocytes in different sample durations in the second group (+ve control group).

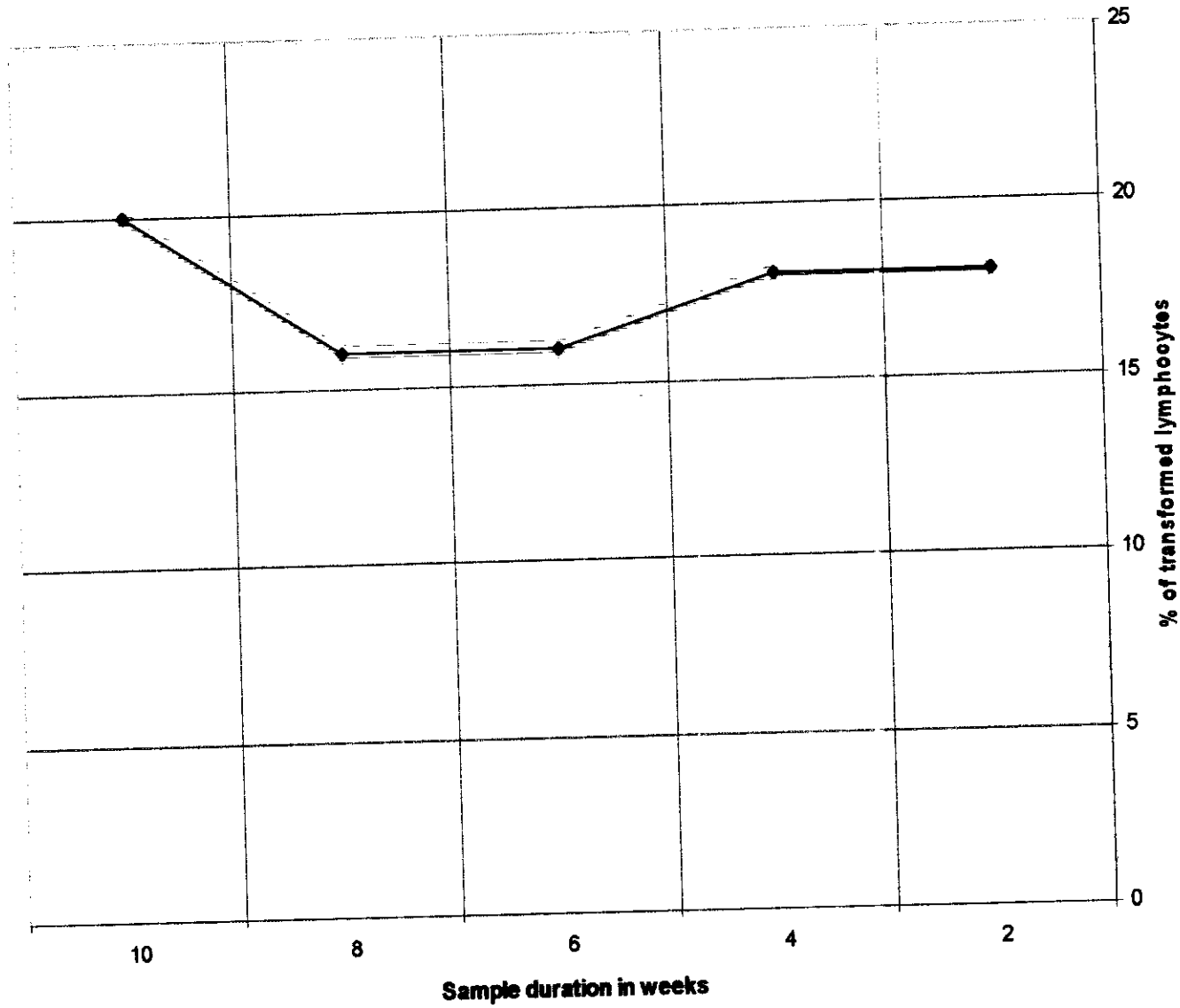


Fig. (34) A photomicrograph of a section in liver obtained from an adult male rat of third group (b) after 2 weeks of administration of CCl_4 showing obvious vacuolation and ballooning of hepatocytes.

[H&E stain., Proj. 10X, Obj. 40X]

Fig. (35) A photomicrograph of a section in liver obtained from an adult male rat of third group (b) after 4 weeks of administration of CCl_4 showing marked ballooning and areas of necrosis within the hepatic lobules (arrow).
[H&E stain., Proj. 10X, Obj. 40X]

Fig. (36) A photomicrograph of a section in liver obtained from an adult male rat of third group (b) after 8 weeks of administration of CCl_4 showing increased areas of necrosis within the hepatic lobules.

[H&E stain., Proj. 10X, Obj. 40X]

Fig. (37) A photomicrograph of a section in liver obtained from an adult male rat of third group (b) 2 weeks after stoppage of CCl_4 administration showing that the areas of necrosis decreased but marked ballooning is still present.

[H&E stain., Proj. 10X, Obj. 40X]

Subgroup (b): The 2 weeks sample showed marked dilatation of the portal tract and accumulation of collagen fibers that were seen around the portal tract and partially extended between the hepatic lobules (Fig. 38). The accumulation of collagen fibers increased until it became extensive by the 8th week so as to bridge the portal tract and surround some hepatocytes (Fig. 39). 2 weeks after stoppage of CCl_4, the accumulation of the collagen fibers was still extensive (Fig. 40).

Toluidine blue stain (semithin sections):

Subgroup (a): (simulating second group) The hepatocytes showed mild ballooning in the 2nd week sample that increased until it became marked in the 8th week sample then the hepatocytes returned to near normal state 2 weeks after stoppage of CCl_4.

Subgroup (b): Hepatocytes showed marked ballooning in the 2 weeks sample (Fig. 41). Detached apoptotic granules were seen inside phagocytic cells which appeared hugely enlarged. Ito cells were mostly empty of granules but some showed small amount of granules (Fig. 42). By the 8th week, the ballooning became extensive with areas of cytoplasmic necrosis and disappearance of cytoplasmic contents (Fig. 43). 2 weeks after stoppage of CCl_4, the cell ballooning and cytoplasmic damage decreased but were still present (Fig. 44).

Fig. (38) A photomicrograph of a section in liver obtained from an adult male rat of third group (b) after 2 weeks of administration of CCl_4 showing accumulation of collagen fibers around a dilated portal tract and extend between the hepatic lobules.

[Masson's trichrome stain., Proj. 10X, Obj. 10X]

Fig. (39) A photomicrograph of a section in liver obtained from an adult male rat of third group (b) after 8 weeks of administration of CCl_4 showing extensive accumulation of collagen fibers bridging the portal tract and surrounding some hepatocytes.

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (40) A photomicrograph of a section in liver obtained from an adult male rat of third group (b) 2 weeks after stoppage of CCl_4 administration showing that the accumulation of collagen fibers is still extensive.

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (41) A photomicrograph of a semithin section liver obtained from an adult male rat of third group (b) after 2 weeks of administration of CCl_4 showing severe ballooning of hepatocytes.

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

Fig. (42) A photomicrograph of a semithin section liver obtained from an adult male rat of third group (b) after 2 weeks of administration of CCl_4 showing detached apoptotic granules inside a phagocytic cell which appears hugely enlarged (arrow). Ito cells were mostly empty of granules but some show small amount of granules.

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

Fig. (43) A photomicrograph of a semithin section liver obtained from an adult male rat of third group (b) after 8 weeks of administration of CCl_4 showing extensive ballooning with cytoplasmic damage of hepatocytes.
[Toluidine blue stain., Proj. 10X, Obj. 100 X]

Fig. (44) A photomicrograph of a semithin section liver obtained from an adult male rat of third group (b) 2 weeks after stoppage of CCl_4 administration showing that ballooning and cytoplasmic damage of hepatocytes decreased but are still present.

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

E/M observations

Subgroup (a): (simulating the second group) The hepatocytes showed partial destruction in the 2 weeks sample that increased to become marked in 8th week sample then returned to normal picture 2 weeks after stoppage of CCl_4 administration.

Subgroup (b): The 2 weeks sample showed areas of cell destruction with complete absence of some cytoplasmic organelles and increased fat droplets (Fig. 45). Destruction of the cytoplasmic contents increased to become extensive at the 8th week with nearly disappearance of the whole cytoplasmic contents but the nucleus was still preserved and slightly elongated (Fig. 46). By the 10th week (2 weeks after stoppage of CCl_4 administration), the damage of the hepatocyte was still evident but some organelles reappeared (Fig. 47).

B) Bone marrow study

Chromosomal study:

Chromosomal pattern and percentage of chromosomal anomalies were similar to that of the control group.

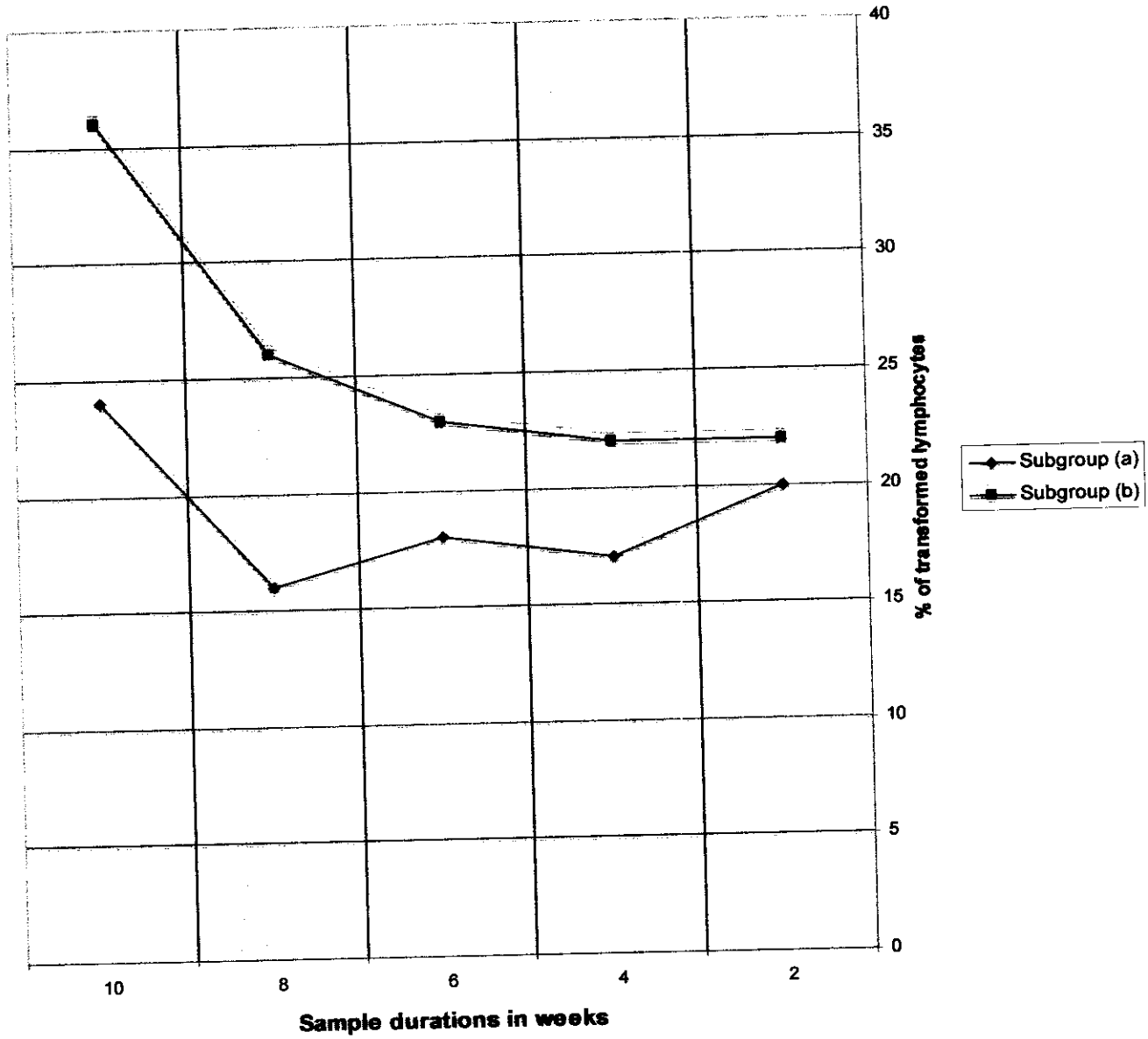
Fig. (45) An electron micrograph of liver obtained from an adult male rat of third group (b) after 2 weeks of administration of CCl_4 showing areas of cell destruction with complete absence of some cell organelles and increased fine fat droplets in the cytoplasm. Ito cell cytoplasm is studded with multiple vitamin A droplets (arrow)

[Uranyl acetate-Lead citrate, 2500 X.]

Fig. (46) An electron micrograph of liver obtained from an adult male rat of third group (b) after 8 weeks of administration of CCl_4 showing nearly disappearance of the whole cytoplasmic contents but the nucleus is still preserved and slightly elongated

[Uranyl acetate-Lead citrate, 3000 X.]

Histogram (3) showing the % of transformed lymphocytes in different sample durations in the third group (vitamin A group)



Fourth group (vitamin C group)

A) Liver study:

Light microscope observations

H&E stain:

Subgroup (a): Hepatic lobules appeared like those of the second group.

Subgroup (b): There was nearly normal hepatic lobule (Fig. 48) in all samples except only in the 8th week sample where minimal ballooning in some hepatocyte was observed (Fig. 49).

Masson's trichrome stain:

Subgroup (a): The accumulation of collagen fibers appeared as that of the second group.

Subgroup (b): There was slight accumulation of collagen fibers around the central veins in the 2 weeks sample that did not increase in all duration samples (Figs. 50 and 51).

Toluidine blue stain (semithin sections):

Subgroup (a): Hepatocytes appeared as those of the second group.

Subgroup (b): The hepatocytes appeared nearly similar to that of the control in all samples (Fig. 52).

Fig. (48) A photomicrograph of a section in liver obtained from an adult male rat of fourth group (b) after 2 weeks of administration of CCl_4 showing cords of normal hepatocytes radiating from a central vein.

[H&E stain., Proj. 10X, Obj. 10X]

Fig. (49) A photomicrograph of a section in liver obtained from an adult male rat of fourth group (b) after 8 weeks of administration of CCl_4 showing very minimal ballooning of hepatocytes

[H&E stain., Proj. 10X, Obj. 40 X]

Fig. (50) A photomicrograph of a section in liver obtained from an adult male rat of fourth group (b) after 2 weeks of administration of CCl_4 showing a little amount of collagen fibers accumulating around the central veins and portal tracts.

[Masson's trichrome stain., Proj. 10X, Obj. 10X]

Fig. (51) A photomicrograph of a section in liver obtained from an adult male rat of fourth group (b) after 8 weeks of administration of CCl_4 showing no increase in the amount of collagen fiber accumulation.

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (52) A photomicrograph of a semithin section in liver obtained from an adult male rat of fourth group (b) after 8 weeks of administration of CCl_4 showing nearly normal hepatocytes with few droplets of lipid infiltration. Blood sinusoids contain RBCs and Kupffer cells.

[Toluidine blue stain., Proj. 10X, Obj. 100 X]

E/M observations

Subgroup (a): Hepatocytes appeared like those of the second group.

Subgroup (b): showed similar picture to that of the control group in all samples (Fig. 53).

B) Bone marrow study

Chromosomal study:

Chromosomal pattern and percentage of chromosomal anomalies were similar to that of the control group

Transformed cells:

Subgroup (a): The average percentage of the transformed cells was within the range of 17% to 22% (Histogram 4 and 6).

Subgroup (b): The average percentage of the transformed cells was within the range of 20% to 26% (Histogram 4 and 6).

Fifth group (vitamin A&C group)

A) Liver study:

Light microscope observations

H&E stain:

Subgroup (a): Hepatocytes appeared as those of the second group.

Subgroup (b): Hepatocytes showed less ballooning and vacuolation at the 2 weeks sample (Fig. 54) but simulated those of the third group in all other samples.

Fig. (53) An electron micrograph of liver obtained from an adult male rat of fourth group (b) after 8 weeks of administration of CCl_4 showing a hepatocyte containing numerous mitochondria, ER, Golgi complexes, many cell inclusions and many small fat droplets. The blood sinusoid contains RBCs.

[Uranyl acetate-Lead citrate, 4000X.]

Histogram (4) showing the % of transformed lymphocytes in different sample durations in the fourth group (vitamin C group).

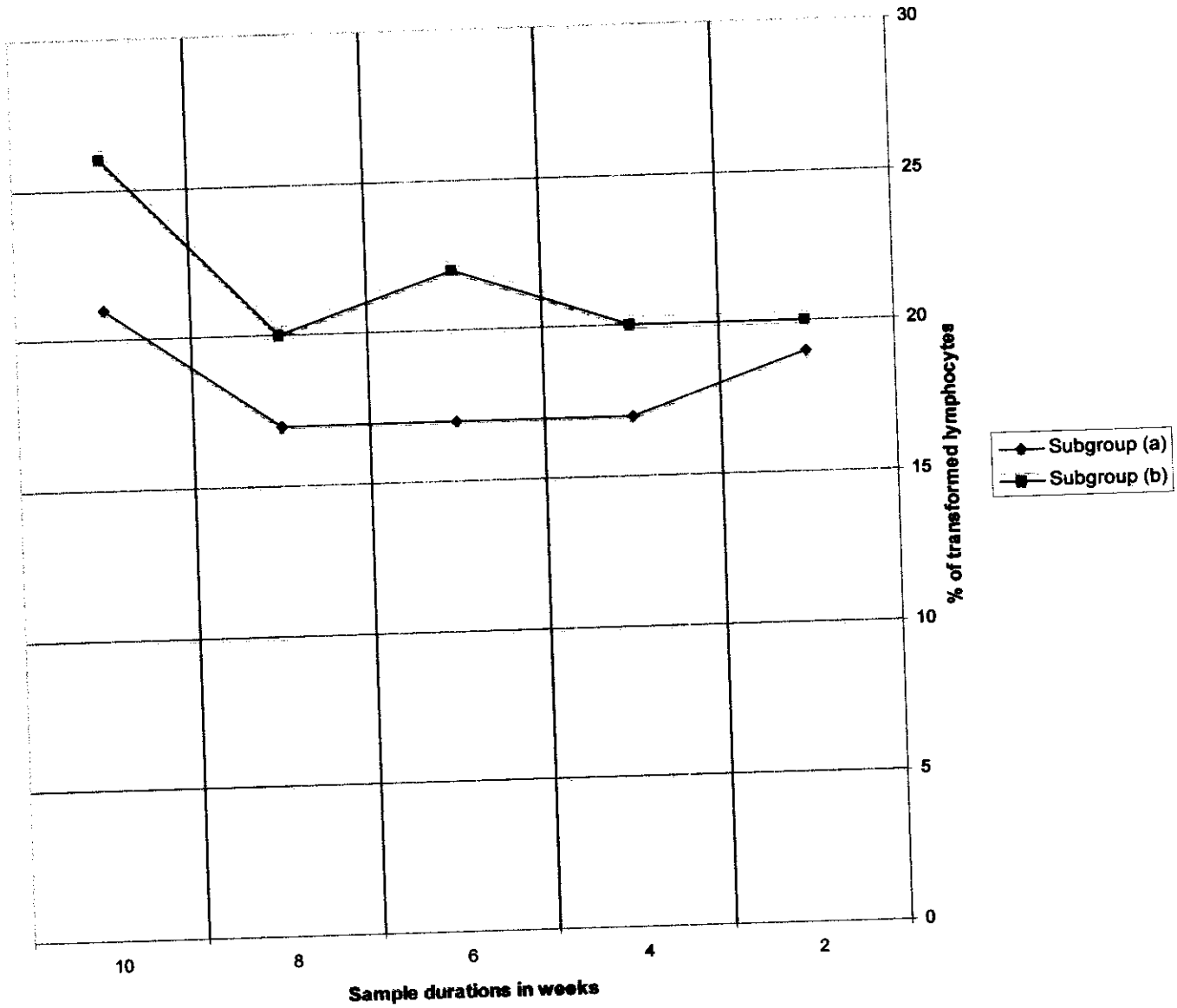


Fig. (54) A photomicrograph of liver obtained from an adult male rat of fifth group (b) after 2 weeks of administration of CCl_4 showing ballooning and vacuolation of hepatocytes **[H&E stain., Proj. 10X, Obj. 40 X]**

Masson's trichrome stain:

Subgroup (a): Collagen fiber accumulation appeared like that of the second group.

Subgroup (b): Collagen fiber accumulation appeared like that of the third group (Fig. 55).

Toluidine blue stain (semithin sections):

Subgroup (a): Hepatocytes appeared as those of the second group.

Subgroup (b): Had a picture simulating that of the third group (Figs.56&57).

E/M observations

Subgroup (a): Had a picture simulating that of the second group

Subgroup (b): Had a picture simulating that of the third group (Fig. 58).

B) Bone marrow study

Chromosomal study:

Chromosomal pattern and percentage of chromosomal anomalies were similar to that of the control group.

Transformed cells:

Subgroup (a): The average percentage of the transformed cells was within the range of 18% to 25% (Histogram 5 and 6).

Subgroup (b): The average percentage of the transformed cells was within the range of 28% to 42% (Histogram 5 and 6).

Fig. (55) A photomicrograph of a section in liver obtained from an adult male rat of third group (b) after 8 weeks of administration of CCl_4 showing extensive accumulation of collagen fibers bridging the portal tract and surrounding some hepatocytes.

[Masson's trichrome stain., Proj. 10X, Obj. 40X]

Fig. (56) A photomicrograph of a semithin section in liver obtained from an adult male rat of fifth group (b) after 2 weeks of administration of CCl_4 showing ballooning of hepatocytes.

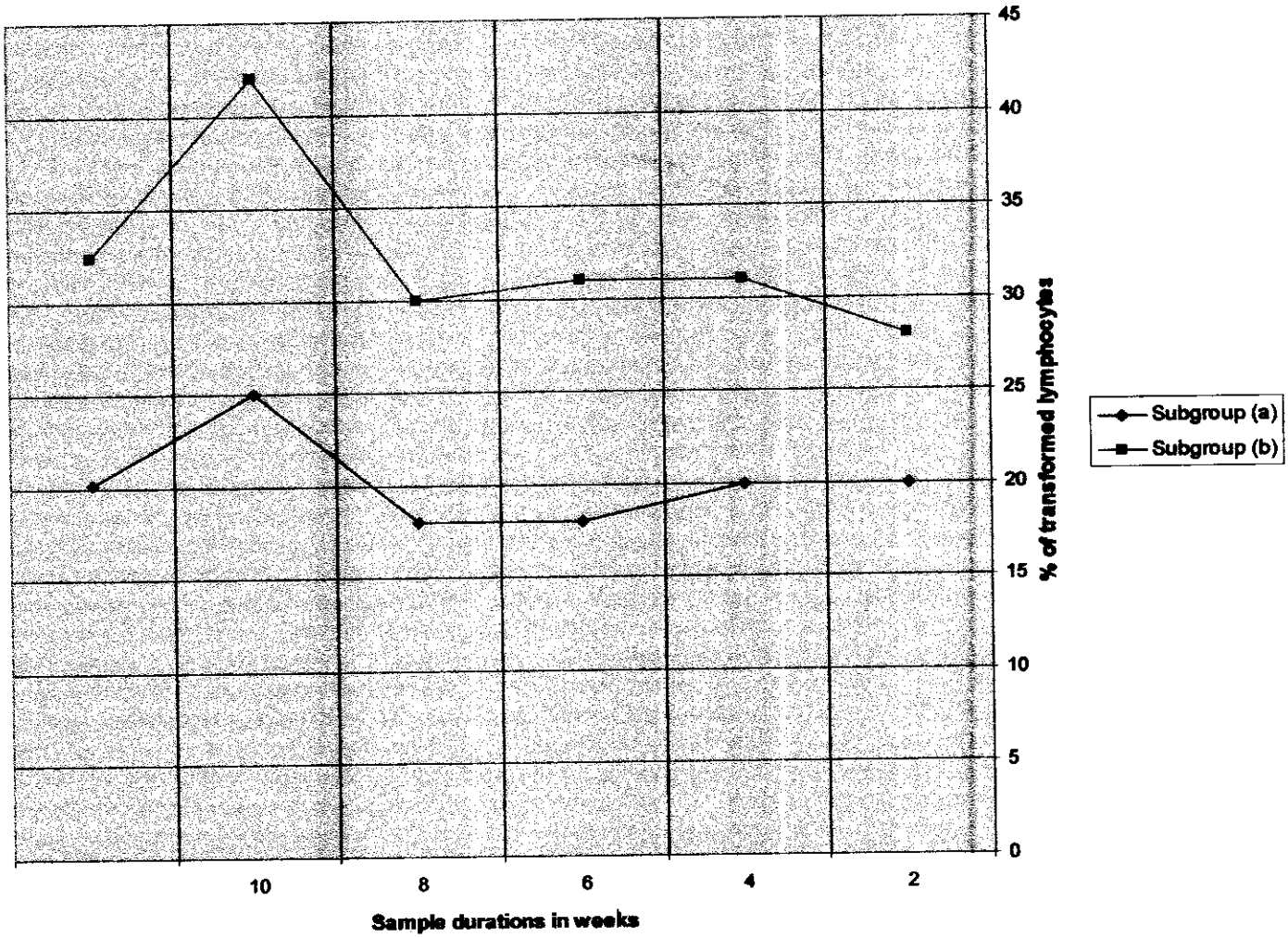
[Toluidine blue stain., Proj. 10X, Obj. 100 X]

Fig. (57) A photomicrograph of a semithin section in liver obtained from an adult male rat of fifth group (b) after 8 weeks of administration of CCl_4 showing marked ballooning of hepatocytes with areas of cytoplasmic damage.
[Toluidine blue stain., Proj. 10X, Obj. 100 X]

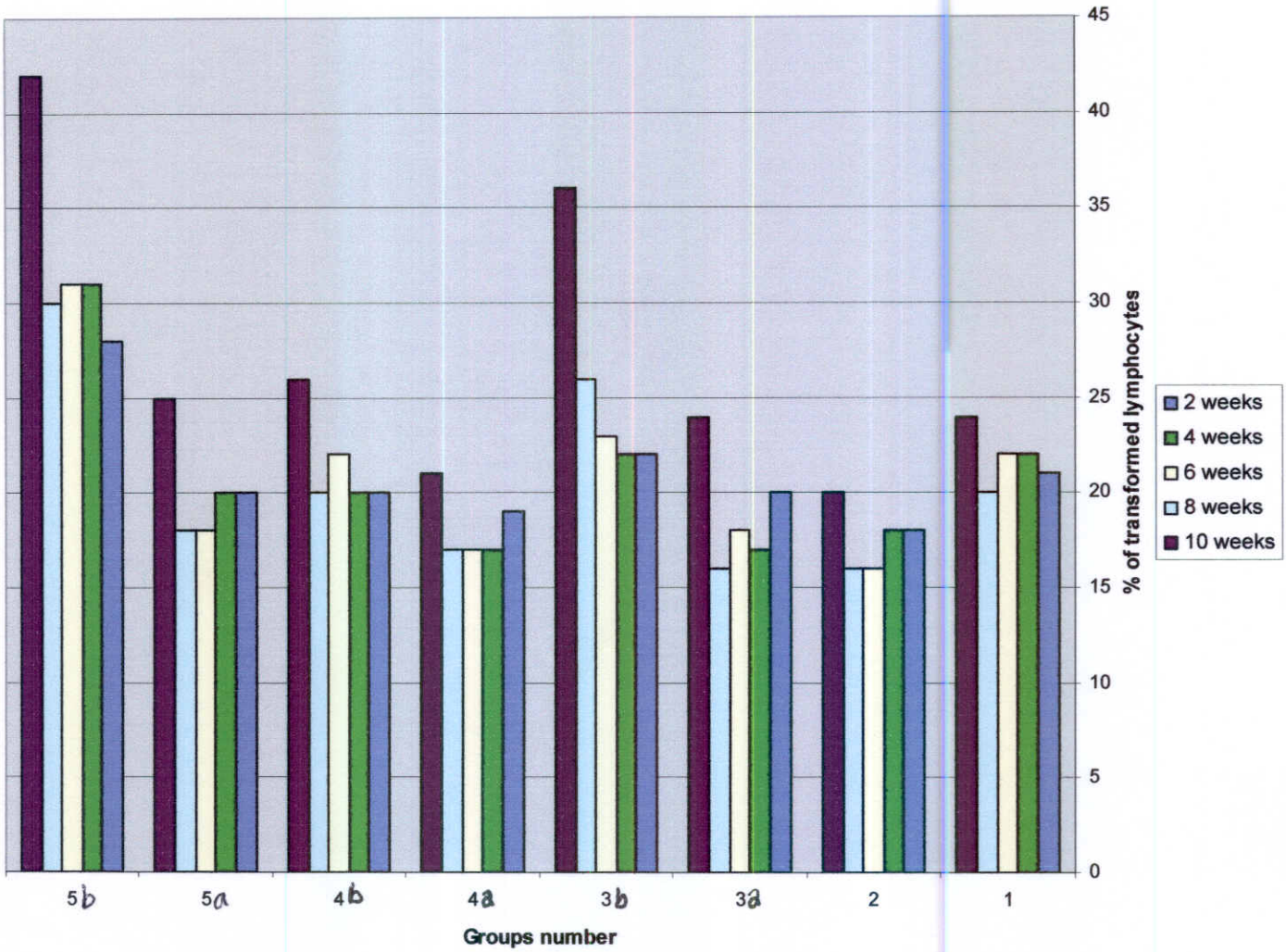
Fig. (58) An electron micrograph of liver obtained from an adult male rat of fifth group (b) 2 weeks after stoppage of CCl_4 administration showing areas of cell destruction with complete absence of some cell organelles. The blood sinusoid contains RBCs. The Ito cell is present at the wall of the sinusoid.

[Uranyl acetate-Lead citrate, 2500 X.]

Histogram (5) showing the % of transformed lymphocytes in different sample durations in the fifth group (vitamin A&C group).



Histogram (6) showing the % of transformed lymphocytes in different groups



Statistics of the transformed cells

Mean, standard deviation (SD) and t-test were conducted for all experimental groups versus the second group (+ve control) [Table 3] and the second group versus the first group (control group) [Table 4].

Statistical analysis:

It revealed that there was a significant increase in transformed cells ($P< 0.01$) in subgroup (b) of both groups (3) and (4) and a highly significant increase ($P< 0.005$) in subgroup (b) of group (5) in relation to the positive control group (group 2). Also there was a highly significant decrease in transformed cells ($P< 0.005$) in positive control group in relation to control group.

Table (3) Showing the mean and standard deviation (S.D.) for the bone marrow transformed lymphocytes of the positive control group (group 2) as well as all experimental groups.

	Group (2)	Group (3)		Group (4)		Group (5)	
		Subgroup (a)	*Subgroup (b)*	*Subgroup (a)*	*Subgroup (b)*	*Subgroup (a)*	*Subgroup (b)*
Mean	17.6	19	25.8	18.2	21.6	20.2	32.4
S.D	1.673	3.162	5.933*	1.789	2.608*	2.864	5.505**

* Significant P < 0.01

** Highly significant P < 0.005

Table (4) Showing the mean and standard deviation (S.D.) for the bone marrow transformed lymphocytes of The control group (group 1) as well as the positive control group (group 2)

	Group (1)	Group (2)
Mean	21.8	17.6
S.D.	1.48	1.673**

* Significant P < 0.01

** Highly significant P < 0.005