BENHA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

BENHA VETERINARY MEDICAL JOURNAL

TERATOLOGICAL EFFECTS OF PRAZIQUANTEL ON FEMALE ALBINO RATS

Abd-Elkhalik A.M.[a], Bakery H.H.[b], El-Shawarby R.M.[b], Nabila M.A.[b]
[a] General authority for veterinary services. [b] Department of Forensic Medicine and Toxicology. Fac. Vet. Med., Banha University

A B S T R A C T

Praziquantel (PZQ) is used widely and effectively in the control of bilharziasis, which constitutes a major health problem in Egypt. However, the extensive use of Praziquantel in multiple reinfections, in non-infected and non-diagnosed individuals for prevention, in higher doses or repeated doses for schistosomiasis treatment makes it necessary to further evaluation of this drug potential. The present study was designed for investigation the teratogenic effects of Praziquantel on fetuses of rats, and studing the histopathological changes on different organs of female albino rats. In this study 30 female albino rats were divided into 3 groups each contain 10 female rats. First group kept as control, second group administrated triple therapeutic dose of Praziquantel (120 mg / kg) by stomach tube daily from sixth to 15th day of pregnancy, third group administrated 2-power 5 dose of therapeutic dose of Praziquantel (200 mg / kg). Both control and treated pregnant females were kept under observation until the 20th day of pregnancy at which they were scarified by decapitation. The obtained results were fetal resorption and skeletal and visceral abnormalities in the other fetuses. In addition, PZQ induced histopathological changes in female uterus as edema and congestion in the lamina propria of the mucosal layer and muscular layer of the uterus.

KEY WORDS: Anthelmintic, Praziquantel, Albino rats, Feti, liver, Uterus.

(BVMJ-24(2): 58-69, 2013)

1. INTRODUCTION

Praziquantel is a synthetic anthelminthic drug has an efficient activity against all species of schistosomes of man & a wide range of cestodes in human tissues &organs, including CNS [1]. Due to its efficiency as a parasiticide [2] and [3], Praziquantel is widely used in Asia, Africa (including Egypt), Latin- American and East-European countries where infections by trematodes and cestodes are frequent [4]. However, recent studies found that extensive use of the drug in multiple re-infections, in non-infected and non-diagnosed individuals for prevention, in higher doses or repeated doses and in conjunction with new findings about its metabolism and teratogenic properities, make it necessary to further evaluation of the drug [4] and [5].

2. MATERIAL AND METHODS

2.1. Experimental animals

Forty apparently healthy albino rats (30 virgin females and 10 sexually mature males) weighting from 180-225 gm were obtained from Egyptian general organization for biological products and vaccine. The animal were housed in iron cage, kept under constant

environmental condition, fed on fresh standard pellet and given tab water.

2.2. Experimental design

In this study 30 female albino rats were divided into three groups each contain 10 female rats First group kept as control, the second group recieved triple therapeutic dose of Praziquantel (120 mg / kg) by stomach tube, third group administrated 2 power five dose of therapeutic dose of Praziquantel (200 mg / kg). All pregnant females were treated given Praziquantel orally by metallic stomach tube daily from 6th to 15th day of gestation (period of organogenesis) during this period, the different organs developed and become more sensitive to the effect of the drug [7], [8], [9] and [10].

2.3. Sampling

Both control and treated pregnant females were kept under observation for any signs of toxicity and weighted periodically until the 20th day of pregnancy at which they were scarified. After scarification, the pregnant females were autopsied for post mortem examination. The maternal liver was removed. The horns of gravid uterus were exteriorized.

2.4. Examination of feti

The maternal uterus was removed without confusing the left and right horns. The isolated uterus was cut open with scissors along the side opposite to implantation sites. The number of implantation sites, resorption sites, live and dead feti was counted. Resorption sites were dark spots when the uterus was immersed in
ammonium sulphide 10% for 20 minutes. The fetuses per each mother were divided into two groups. The first group was two-thirds of the obtained feti. They were kept in Bouin,s solution for exploring the visceral abnormalities. The second group was the rest of feti. They were eviscerated and kept in 95% ethanol for investigation of any skeletal malformations.

2.5. Histopathological examination

Specimens were collected from uterus from each sacrificed mother of the tested rats in different groups and fixed directly in 10% formalin and kept for histopathological examination under light microscope.

3. RESULTS

Females received 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy showed highly characteristic signs as No. of feti in one horn more than the other (figure 1). The effect of triple therapeutic dose of praziquantel administrated to female rat from 6th to 15th day of pregnancy on fetuses showed reduction of resorption sites and only one female showed resorption of one site (table 1). The effect of 2 power five dose of therapeutic dose of praziquantel administrated to female rat from 6th to 15th day of pregnancy showed increases in the number of resorbed feti (table 2).

The effect triple and 2 power five doses of therapeutic dose of PZQ on weight & length of the feti showed that praziquantel cause retardation of growth in developing feti during period of gestation (table 3) and (figure 2). Skeletal abnormalities in feti from females after oral administration of triple therapeutic dose of PZQ from 6th to 15th day of pregnancy were non-significant comparatively to the control as the skull abnormalities were ranged from irregular shape of os baso-occipital and os squamosum to large distance of os frontale (table 4) & (figure 3).The digital abnormalities were ranged from absence of one or more to irregular shape. No abnormalities were revealed of metacarpal or metatarsal bone. While skeletal abnormalities in feti from females after oral administration of 2 power five dose of therapeutic dose of PZQ from 6th

Table (1): The effect of triple therapeutic dose of praziquantel administrated to female rat from 6th to 15th day of pregnancy showing No. of female rat/each group, No. of feti, No. of viable and dead feti and No. of resorbed feti/mother compared to control group.

Rat female No.	No.of fetuses/mother		No. of viable fetuses/mother		No. of dead fetuses/mother		No. of resorbed fetuses/ mother	
	Control	*PZQ 3^D	Control	*PZQ 3^D	Control	*PZQ 3^D	Control	*PZQ 3^D
1	4	4	4	4	-	-	-	-
2	7	10	7	10	-	-	-	-
3	10	7	10	7	-	-	-	1
4	8	6	8	6	-	-	-	-
5	7	7	7	7	-	-	-	-
6	11	8	11	8	-	-	-	-
7	9	6	9	6	-	-	-	-
8	10	7	10	7	-	-	-	-
9	8	5	8	5	-	-	-	-
10	10	6	10	6	-	-	-	-
X	8.4	6.6	8.4	6.6	0	0	0	1
S.E	0.65	0.52	0.65	0.52	0	0	0	0.1

*PZQ 3^D = Triple therapeutic dose of Praziquantel.

Table (2): The effect of 2 power five dose of therapeutic dose of praziquantel administrated to female rat from 6th to 15th day of pregnancy showing No. of female rat/each group, No. of feti, No. of viable and dead feti and No. of resorbed feti/mother compared to control group.

Rat female No.	No .of fetuses/mother		No. of viable fetuses/mother		No. of dead fetuses/mother		No. of resorbed fetuses/ mother	
	Control	*PZQ.5^D	Control	*PZQ.5^D	Control	*PZQ.5^D	Control	*PZQ.5^D
1	4	7	4	4	-	-	-	-
2	7	9	7	9	-	-	-	-
3	10	5	10	5	-	-	-	-
4	8	9	8	9	-	-	-	-
5	7	9	7	9	-	-	-	-
6	11	5	11	5	-	-	-	1
7	9	5	9	5	-	-	-	1
8	10	5	10	5	-	-	-	-
9	8	6	8	6	-	-	-	-
10	10	4	10	4	-	-	-	-
X	8.4	6.4	8.4	6.4	0	0	0	2
S.E	0.65	0.61	0.65	0.61	0	0	0	0.13

*PZQ 5^D = 2power five dose of therapeutic dose of Praziquantel.

Table (3): Showing mean fetal body weight and length of female rat administered triple and 2 power five doses of therapeutic dose of praziquantel from 6th to 15th day of pregnancy compared with control group.

No. of female rat in each Group	Mean fetal body wt (g)			Mean fetal body length (cm)		
	Control	PZQ 3^D	PZQ 5^D	Control	PZQ 3^D	PZQ 5^D
1	5	4	4	5	4	4
2	6	3.5	4	5	3.5	3.5
3	5	3	4	4.5	3.5	3.5
4	4	3	4	5	3.5	4
5	6	4	3.5	5	4	3.5
6	5	4	4	5	3.5	3.5
7	5	3	3.5	5.5	4	4
8	5	3.5	4	4.5	4	3.5
9	6	4	3	5	3.5	3.5
10	5	3	3	5	3.5	4
X	5.2	3.8	3.7	4.9	3.7	3.7
S.E	0.2	0.15	0.13	0.089	0.082	0.082

Table (4): Skeletal abnormalities in feti from females after oral administration of triple therapeutic dose of Praziquantel from 6th to 15th day of pregnancy.

Female rat No.	No. of examined feti/mother	Skull No.	Vertebral column No.	Ribs No.	Sternum No.	Digits bone No.	Metacarpal bone No.	Metatarsal bone No.
1	1	-	1	-	-	1	-	-
2	3	2	-	-	-	2	-	-
3	2	1	-	-	-	-	-	-
4	2	-	-	-	-	1	-	-
5	2	-	-	-	-	-	-	-
6	2	1	-	-	-	-	-	-
7	2	-	-	-	-	-	-	-
8	2	-	1	-	-	1	-	-
9	1	-	-	-	-	-	-	-
10	2	1	-	-	-	-	-	-
Total	19	5	2	0	0	5	0	0
*(%)	29%	26%	10%	0	0	26%	0	0

*(%): Percent of total abnormalities in relation to the number of examined fetuses.

Table (5): Skeletal abnormalities in feti from females after oral administration of 2 power five dose of therapeutic dose of Praziquantel from 6th to 15th day of pregnancy.

Female rat No.	No. of examined feti/mother	Skull No.	Vertebral column No.	Ribs No.	Sternum No.	Digits bone No.	Metacarpal bone No.	Metatarsal bone No.
1	1	-	1	-	-	1	-	-
2	3	2	2	-	-	2	1	1
3	1	-	-	-	-	-	-	-
4	3	2	2	-	-	1	2	2
5	3	1	2	-	-	2	1	1
6	1	1	1	-	-	1	-	-
7	1	-	-	-	-	-	-	-
8	1	-	1	-	-	1	-	-
9	2	2	2	-	-	1	1	1
10	1	-	-	-	-	-	-	-
Total	17	8	11	0	0	9	5	5
*(%)	26.5%	47%	64%	0	0	52%	29%	29%

*(%): Percent of total abnormalities in relation to the number of examined fetuses.

Table (6): Visceral malformation in feti from females after oral administration of triple therapeutic dose of PZQ from 6th to 15th day of pregnancy.

Female rat No.	No. of examined feti/mother	Microcephall	Thymus hypoplasia	Thymus absence	Heart hyperplasia	Lung hyposlasia	Liver hyperplasia
1	3	-	-	-	1	1	1
2	7	-	2	-	2	2	4
3	5	-	1	-	1	1	3
4	4	-	1	-	-	-	2
5	5	-	1	-	1	1	2
6	6	-	2	-	2	2	3
7	4	-	-	-	-	-	2
8	5	-	1	-	1	1	2
9	4	-	-	-	-	-	1
10	4	-	-	-	1	1	1
Total	47	-	8	-	9	9	21
*(%)	71%	0	17%	0	19%	19%	44.6%

*(%): Percent of total abnormalities in relation to the number of examined fetuses.

Table (7): Visceral malformation in feti from females after oral administration of 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy.

Female rat No.	No. of examined feti/mother	Microcephall	Thymus hypoplasia	Thymus absence	Heart hyperplasia	Lung hyposlasia	Liver hyperplasia
1	6	-	2	-	3	3	4
2	6	-	2	-	2	2	3
3	4	-	1	-	1	1	2
4	6	-	1	-	2	2	4
5	6	-	2	-	1	1	4
6	4	-	1	-	1	1	2
7	4	-	-	-	-	-	3
8	4	-	1	-	1	1	2
9	4	-	-	-	2	2	2
10	3	-	-	-	1	1	1
Total	47	-	10	-	14	14	27
*(%)	73%	0	21%	0	29.7%	29.7%	57%

*(%): Percent of total abnormalities in relation to the number of examined fetuses.

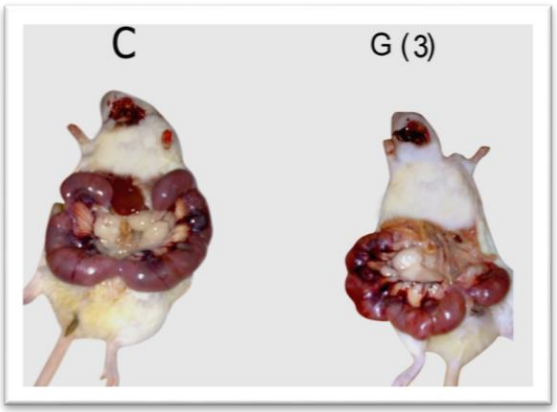

Figure (1)

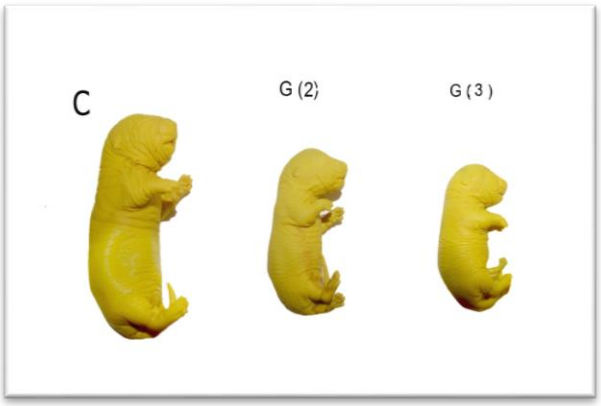

Figure (2)

Fig., (1): Gravid uterus obtained from mother administered triple and 2 power five dose of therapeutic dose of Praziquantel from 6th to 15th day of pregnancy showed No. of feti in one horn more than the other. Fig., (2): Retardation of growth in a feti obtained from mother administered triple and 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy.

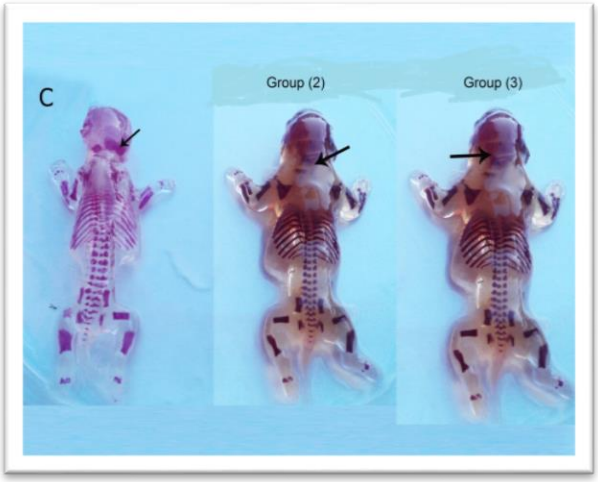

Figure (3)

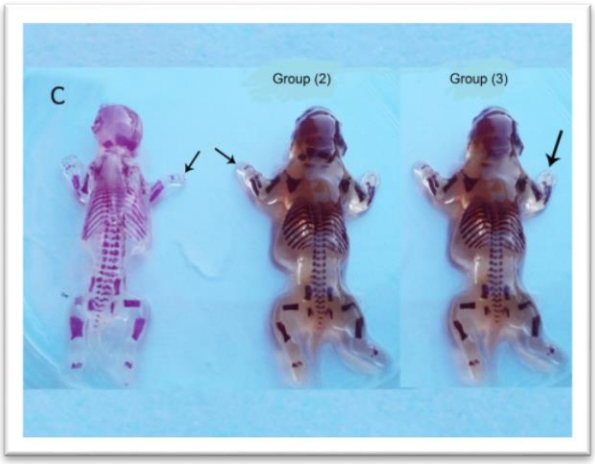

Figure (4)

Fig., (3): Impaired ossification of skull in a feti obtained from mother administered triple and 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy. Fig., (4): Absence of digit's bone in a fetus obtained from mother rats administered triple and 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy.

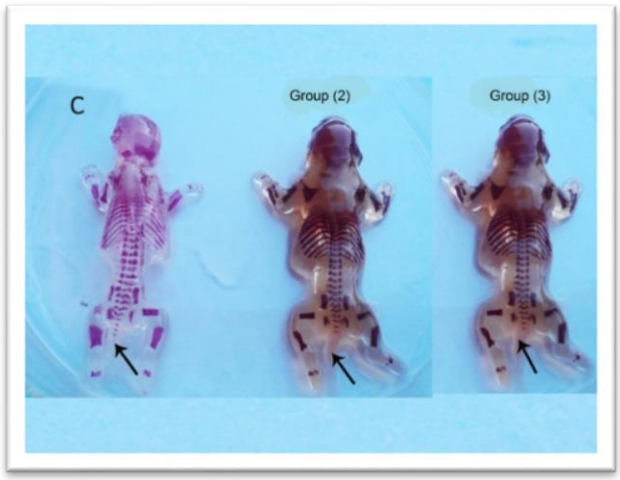

Figure (5)

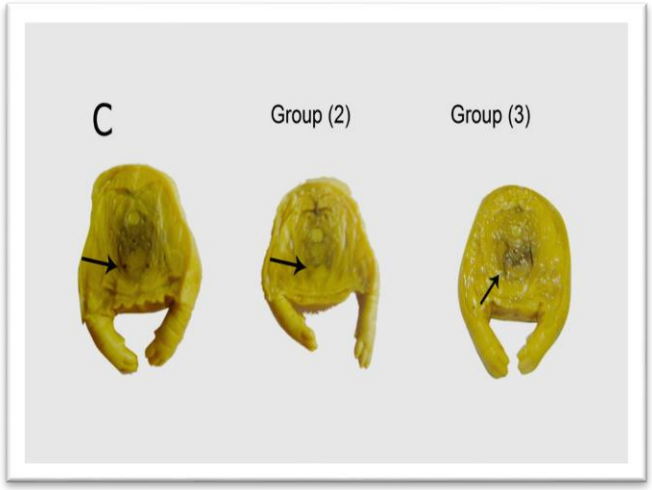

Figure (6)

Fig., (5): Absence of some caudal vertebrae in a feti obtained from mother rats administered triple and 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy. Fig., (6): Thymus hypoplasia in feti obtained from mother rats administered triple and 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy.

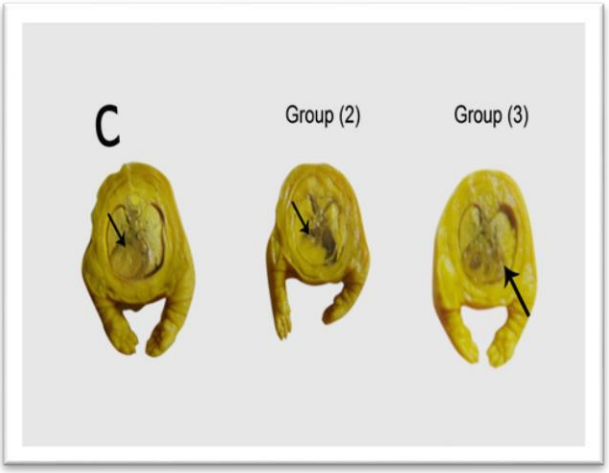

Figure (7)

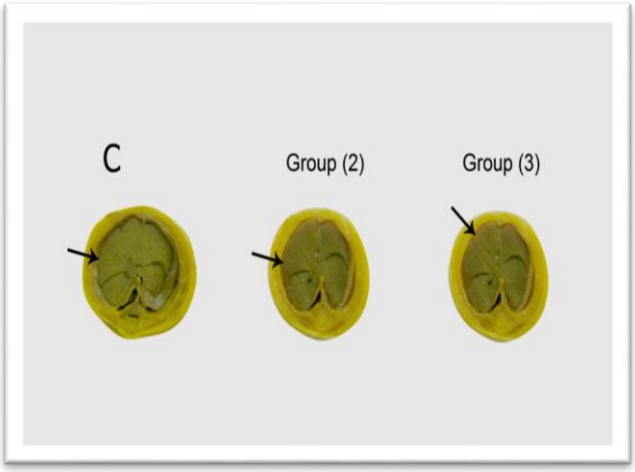

Figure (8)

Fig., (7): Pulmonary hypoplasia with cardiac enlargement in fetus obtained from mother rats administered triple and 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy. Fig., (8): Hepatomegaly in fetus obtained from mother rats administered triple and 2 power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy.

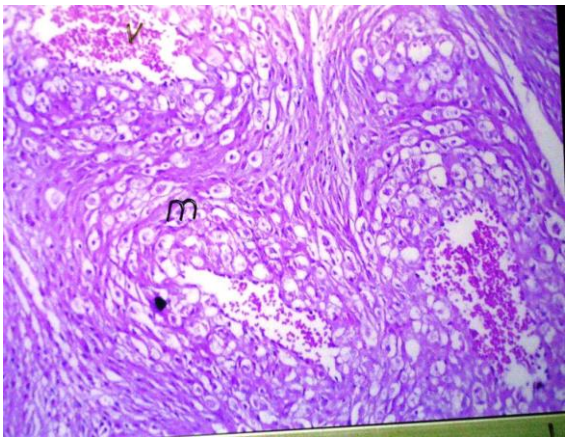

Figure (9)

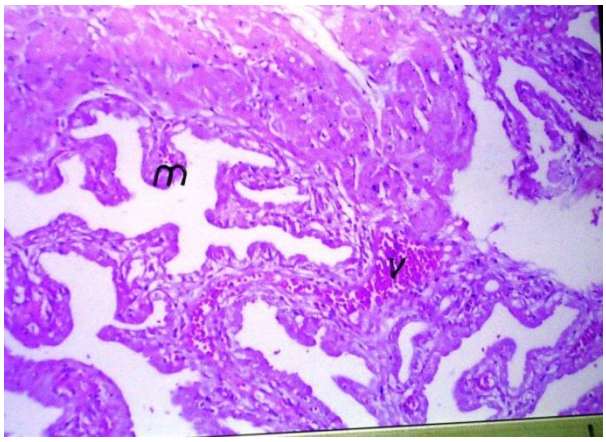

Figure (10)

Fig., (9): uterus of rat administered triple therapeutic dose of Praziquantel from 6th to 15th day of pregnancy showed oedema and congestion in the lamina propria of the mucosal layer. Fig., (10): uterus of rat administered2 power five dose of therapeutic dose of Praziquantel from 6th to 15th day of pregnancy showed hyperplasia with polyps formation with congestion in the blood vessels in underlying lamina propria.

to 15th day of pregnancy were slightly significant as the skull abnormalities ranged from absence of one or more to irregular shape, and of vertebral column ranged from impaired calcification is the most significant also was absence of some caudal vertebrate. The digital abnormalities mostly were absence of digits (table 5) (figure 3, 4&5).

The visceral malformation observed in feti from females after oral administration of triple and power five dose of therapeutic dose of PZQ from 6th to 15th day of pregnancy were slightly significant and the lesion resulted in different organs was a dose dependent. We found thymus hypoplasia without any thymus absence, cardiac enlargement, pulmonary hypoplasia and hepatomegaly of the liver of the examined feti (table 6&7) (figure 6, 7&8 respectively).

The histopathological effect of triple and power five dose of therapeutic dose of PZQ on uterus of female rats were dose dependent, found that PZQ produce oedema and congestion in the lamina propria of the mucosal layer (Figure 9), associated with oedema and congestion in the muscular layer (Figure 10).

4. DISCUSSION

Praziquantel is an anthelmintic drug effective against many species of cestodes and trematodes. Since its approval, the studies concerned with the hepatotoxic, genotoxic and carcinogenic effects of praziquantel which indicated that the drug has a remarkable safety profile [1] and [11].

Under the condition of the current study, some adverse clinical signs appear in rats received triple and 2power five therapeutic doses of praziquantel during the period of organogenesis (from 6th to 15th day of pregnancy) this side effects like: weakness, loss of appetite and general depression.

The post-mortem changes on the female rats received triple and 2power five therapeutic dose of PZQ appeared as, lungs congestion and the liver were enlarged, soft and friable in tincture. The gravid uterus showed reduction in size and showed uterine peticheal hemorrhage and showed decrease in the number of feti in one horn than the other and in some cases, the pregnancy occurs in one horn. Oral administration of Praziquantel by using stomach tube in triple and 2 power five doses of therapeutic dose (120 and 200 mg/kg b.wt) to female pregnant rats induced marked and significant decrease in the number of fetuses / mother when compared with the recorded value of the control group. This result was consistent with the data reported by [4] after administration of Praziquantel in high doses to pregnant rats between the 6th and 10th day of gestation, fetal death and fetal resorption were found and evidence of embryotoxic effect in a particular stage of rat embryological development. Also [12] said that fetal death and fetal resorption were found when praziquantel was administered in high doses to pregnant rats between the 6th and 10th day of gestation. The high volume of distribution of praziquantel and its metabolites suggests that it can enter the placenta. The increase in the number of resorbed fetuses in the present study may be attributed to the interference of the drug to the placental transmission of leucin amino acid and magnesium as deficiency of leucin or magnesium produced high incidence of fetal resorption [13]. Praziquantel in triple and 2 power five doses of therapeutic dose didn't induce any fetal death.

Administration of Praziquantel in triple and 2 power five doses of therapeutic dose to pregnant female rats during the period of organogenesis produce highly significant decrease in both weight and length of fetuses when compared with the recorded value of the control group. The obtained result is a dose-dependent. The recorded reduction in fetal weight and length which resulted after oral administration of tested drug might be attributed to the disturbance in metabolism of some minerals as magnesium and zinc in

fetus, or to the interference of the drug to the placental transmission of magnesium and zinc from the mother to the fetus. [13] proved that deficiencies of magnesium and zinc induce retardation of fetal growth, increasing fetal resorption and high rate of embryonal death. Concerning to the effect of Praziquantel in triple and 2 power five doses of therapeutic dose to pregnant female rats during the period of organogenesis resulted in hypoplasia of thymus gland, which is a dose dependent. This result might be attributed to cytotoxicity of praziquantel as the drug promotes cell death. [4] in vitro studies have demonstrated that Praziquantel can induce micronuclei in Syrian hamster embryonic (SHE) cells and in lymphocytes of some individuals.

In this study, it was found that administration of Praziquantel in triple and 2 power five doses of therapeutic dose to pregnant female rats during the period of organogenesis produced cardiac hyperplasia which is a dose-dependent. This lesion might be attributed to the fact that PZQ increase incidence of cardiomyopathy in females as endocardial neoplasm and Schwann cell like hyperplasia. [6] found that praziquantel induced a significant increase in the incidence of mutagenicity and genotoxicity [14]. Administration of Praziquantel produces hepatomegally. This result was consistent with the data reported by [6] whom recorded that after administration of praziquantel to rats induced a significant area of hyaline degeneration, fatty changes, dysplasia and necrosis in the liver sections were induced, this lesion might be attributed to the fact that PZQ increase incidence of carcinogenicity. In our study administration of Praziquantel in triple and 2 power five doses of therapeutic dose to pregnant female rats during the period of organogenesis produced some skeletal malformations such as impaired ossification of skull, reduction of caudal vertebrae, absence of digit's bone of fore and hind limbs and absence of some metacarpal and metatarsal bone. The recorded skeletal malformations might be attributed to fact of Praziquantel induced arthropathy due to ability of PZQ to form chelat complex of functionally available magnesium so it led to deficiency of magnesium in joint cartilage which impair condrocyte matrix. Also, deficiency of magnesium cause high calcium concentration which stimulate release of lysosomal enzyme and enable them to break down precellular matrix as interleukin-I. The cause of bone lesion may be attributed to deficiency of functionally available magnesium, inhibition of mitochondrial dehydrogenase, proteoglycan synthesis, alter mechanism of DNA polymerase, tissue accumulation of floride and increase the respiratory burst in chondrocytes [4]. The histopathological changes of uterus mainly oedema and congestion in the lamina propria of the mucosal layer, associated with oedema and congestion in the muscular layer, the mucosal lining epithelium showed hyperplasia with polyps formation with congestion in the blood vessels in underlying lamina propria. This lesion might be attributed to carcinogenic and cytotoxic effect of the drug due to effect of the drug on magnesium and release of lysosomal enzyme [6]. In conclusion, Praziquantel has adverse clinical signs. PZQ is a toxic substance in high doses that causes changes in liver and uterus. Praziquantel has a terratological effects that cause retardation in fetal weight and length also PZQ cause skeletal and visceral abnormalities.

5. REFERENCES

1. Frohberg H. 1984. Results of toxicological studies on Praziquantel, Arzneim.-forsch. Drug Res. 34(2): 1137-1144.

2. Takafira M., Francisca M., Tinashe R., Daniel K., Nicholas M. and Patricia D. N. 2009. Similar cellular responses after

treatment with either praziquantel or oxamniquine in Schistosoma mansoni infection. Malawi Medical Journal. 21(4):176-181.

3. Rujeni N., Nausch N., Midzi N., Mduluza T., Taylor D.W. and Mutapi F. 2012. Schistosoma haematobium infection levels determine the effect of praziquantel treatment on anti-schistosome and anti-mite antibodies. Parasite Immunol. 34(6): 330–340.
4. Montero R. and Ostrosky P. 1997. Genotoxic activity of Praziquantel. Mutation Research 387: 123-139.
5. David A., Jose M., Joaquin G., Maria E. and Manuel C. 2006. Failure of standard treatment with Praziquantel in two returned travelers with Schistosoms haematobium infection. Am. J. Trop. Med. Hyg. 74(2). 342–344.
6. Omar A. M.A., Ghada E. and Shereen E. 2005. Comparative study of the hepatotoxic, genotoxic and carcinogenic effects of Praziquantel and the natural Myrrh extract on adult male albino rats. J. Egypt. Soc. Parasitol. 35(1): 313-329.
7. Delgado I.F., Carvalho R.R., Nugueira A.C.M. A., Mattos A.P., Figueiredo L. H., Oliveira S.H. P., Chahoud I. and Paumgartten F.J. R. 1993. Study on the embyofoetotoxicity of β-mercene in the rat. Food and chemical toxicology. 31: 31-35.
8. Noguira A.C. 1995. Study of the emberyofeto-toxicity of citral in the rat. Toxicology. 96: 105-113.
9. Paumgarten F. J. R, Souza C. A. M., Carvalho R. R. and Chahoud I. 1995. Embryo-toxic effects of mesoprostol in mouse.Brazilian J. of Med. And Biol. Res. 28: 355-361.
10. Arauja I.B., Souza C.A.M., Carvalho R.R., Kuriyama S.N., Rodrigues R.P., Vollmer R., Alves E.N. and Paumgartten F.J.R. 1996. Study of the emberyofeto-toxicity of α-terpinal in rat. Food and chemical toxicology. 34(5): 477-482.
11. Anwar W.A. 1994. Praziquantel (antischistosomal drug): is it clastogenic, co-clastogenic or anticlastogenic? Mutat. Res. 305(2): 165-173.
12. Frohberg H. 1989. The toxicological profile of Praziquantel in comparison to other anthelminthic drugs. Acta. Leidenssia. 57: 201-215.
13. Tuchman-Duplessis H. 1975. Drug effects on the fatus foetus ADIS press, New Yourk, USA. 4(11): 785-6.
14. Rosenkranz H.S., Zhang Y.P. and Klopman G. 1995. Risk identification using structural concepts: the potential carcinogenicity of praziquantel. Regul. Toxicol. Pharmacol. 22(2): 152-161.

التأثيرات المشوهة للأجنة لعقار البرازيكوانتيل في اناث الفئران البيضاء

أكرم محمود عبد الخالق[1]، حاتم حسين بكرى[2]، رجب محمود الشواربى[2]، نبيلة محمود عبد العليم[2]
الهيئة العامة للخدمات البيطرية، [2] قسم الطب الشرعي والسموم. كلية الطب البيطري. جامعة بنها

الملخص العربى

البرازيكوانتيل دواء يستخدم على نطاق واسع بفاعلية للقضاء على البلهارسيا التي تشكل مشكلة صحية كبيرة في مصر. ولكن الاستخدام الواسع النطاق للبرازيكوانتيل في العدوى المتكررة وفى حالة عدم تشخيص الافراد المصابين وغير المصابين للوقاية، بجرعات عالية او متكررة لعلاج البلهارسيا يجعل من الضروري مواصلة تقييم امكانيات هذا الدواء. وقد أُجريت هذه الدراسة بهدف استبيان التأثير السمي للبرازيكوانتيل مع التركيز على التأثير التشوهى للأجنة اثناء فترة تكوين الأعضاء، أيضا التغيرات التشريحية المرضية للأحشاء الداخلية للأمهات الفئران. وقد أُجريت هذه الدراسة على عدد 30 فأر أبيض من الاناث وقد قسمت الاناث الحوامل الى ثلاثة مجموعات متساوية. المجموعة الاولى كمجموعة ضابطة، المجموعة الثانية أعطيت ثلاثة أضعاف الجرعة العلاجية من البرازيكوانتيل (120 مجم / كجم) من وزن الجسم عن طريق أنبوبه معديه من اليوم السادس الى اليوم الخامس عشر من الحمل، المجموعة الثالثة أعطيت خمسة أضعاف الجرعة العلاجية من البرازيكوانتيل (200 مجم / كجم) من وزن الجسم. وتم متابعة الفئران الحوامل في المجموعات الثلاثة حتى اليوم العشرين من الحمل. قد لوحظت النتائج التالية، ارتشاف(امتصاص) الأجنة وتشوهات في الأحشاء الداخلية وتشوهات في الهيكل العظمى للأجنة. بالإضافة الى ذلك يؤدى البرازيكوانتيل الى تغيرات تشريحية مرضية (تغيير هستوباثولوجى) في رحم أمهات الفئران مثل احتقان ووذمات في الطبقة المخاطية والطبقة العضلية للرحم.

(مجلة بنها للعلوم الطبية البيطرية: عدد 24 (2)، يونيو 2013:58-69)