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Assessment of Fertility after Testicular Torsion: An Experimental Study

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Summary. The spermatic cord was ligated in Charles River adult rats producing viable reversible and non viable damaged testes. Weight of the rats, weight of the testes, weight of the epididymis, sperm motility, sperm concentration and fertility were the different parameters assessed. The results showed that there is a high percentage of subsequent atrophy in the ligated testes, and that there is a definite correlation between the length of the occlusion and the amount of testicular injury sustained. Leaving a ligated testis in situ for three months provoked a severe reduction in fertility and some lesser reduction in the sperm motility in the contralateral testis. This damage was not observed in the rats where the ligated testes were removed.

Keywords: Testicular torsion, Fertility, Orchiopexy, Orchiectomy, Spermatogenesis, Testicular atrophy.

Introduction

Does unilateral torsion with resultant damage to spermatogenic elements induce degenerative changes in the contralateral testis? Should an infarcted testis be reintegrated in the scrotum after detorsion or be excised? Since there is controversion in the literature on this subject, an experimental study on rats was carried out in order to investigate the fate of the contralateral testis after unilateral testicular torsion.

Material and Methods

Adult male Charles River strain rats were randomly divided into seven groups of 8 to 10.

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Group 1: a bilateral orchiectomy was performed through an abdominal incision. They served as control group 1.

Group 2: a unilateral orchiectomy was performed. The contralateral testis was removed three months later, at the end of the experiment. They served as control group 2.

Group 3: a unilateral ligation of the spermatic cord with catgut was done. Three hours later the ligation was released. Three months later bilateral orchiectomy was performed.

Group 4: a unilateral ligation of the spermatic cord with catgut was performed. Three hours later the ligated testis was excised. The contralateral testis was excised 3 months later.

Group 5: a unilateral ligation was done as in group 3, but reopened only after 24 h. Bilateral orchiectomy was performed 3 months later.

Group 6: ligation for 24 h, then orchiectomy of the injured testis. Contralateral testes excised 3 months later.

Group 7: a bilateral orchiectomy was performed three months after the beginning of the study. They served as control group 3.

The ligations of the spermatic cords were carried out through an abdominal incision. The ligature was tight enough to provoke a venous congestion but not complete ischaemia of the testis. In groups 3 and 4, the wound was reopened after 3 h. The testes were cyanotic and oedematous, but returned to a normal colour in group 3 after release of the ligature and washing with warm saline. In groups 5 and 6 the wound was reopened after 24 h. The testes were dark blue and did not recover their normal colour after release of the ligature.

The fertility of the rats was assessed three months after the start of the study by placing the rat in a separated cage with a fertile female for two weeks. Females which were not fecondated were replaced by others for another 2 weeks.

At the end of the 3 months period, all the rats were castrated. In all castrations, whether immediately or after three months, the testes and epididymides were separated from one another, weighed in grams and then examined under the microscope. Sperm motility was assessed in percentage of the preparation and sperm concentration was counted in 10^6/cc.

Results

Two rats died during the 3 months of the experiments. No significant fluctuations in the weights of living rats were noted during this period excepted for gain in weight due to natural growth.

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Table 1. Summarized results

Group		Weight of rat		Right side or ipsilateral				Left side of contralateral				Fertility [%]
		Before	After	Weight of testis	Weight of epididyme	Sperm mobility [%]	Sperm concentration in 10^6/1cc	Weight of testis	Weight of epididyme	Sperm motility [%]	Sperm concentration in 10^6/1cc	
1.	$\bar{M}$	220	345	1.2	0.3	100	28.5	1.2	0.3	100	29	0
$n = 8$	S.D.	20.5	20	0.1	0.04	0	13	0.1	0.02	0	12.8	–
	S.E.	7.2	8.0	0.05	0.01	0	4.6	0.04	0.01	0	4.5	–
2.	$\bar{M}$	208	333	1.2	0.3	100	26	1.5	0.5	100	51	100
$n = 8$	S.D.	34.8	24	0.1	0.09	0	18	0.1	0.07	0	15	–
	S.E.	6.0	8.0	0.04	0.03	0	5	0.05	0.02	0	5	–
3.	$\bar{M}$	236	441	0.4	0.3	0	0	1.5	0.6	100	80	63
$n = 8$	S.D.	13	86.5	0.2	0.06	0	0	0.2	0.06	0	40	–
	S.E.	4.5	30.6	0.06	0.02	0	0	0.06	0.02	0	14	–
4.	$\bar{M}$	241	408	1.2	0.3	30	20	1.6	0.5	100	65	70
$n = 10$	S.D.	46	102	0.2	0.1	28	23	0.2	0.09	0	13	–
	S.E.	14.6	32	0.06	0.04	9	7	0.05	0.03	0	4	–
5.	$\bar{M}$	230	350	No testicular nor epididymal tissues				1.3	0.5	81	65	0
$n = 7$	S.D.	29	15	were found				0.4	0.1	31	22	–
	S.E.	11	5					0.2	0.04	12	8	–
6.	$\bar{M}$	213	356	0.9	0.3	0	2.4	1.3	0.5	100	55	86
$n = 7$	S.D.	23	24	0.2	0.1	0	1.7	0.4	0.1	0	44	–
	S.E.	9	9	0.06	0.03	0	0.9	0.1	0.03	0	16	–
7.	$\bar{M}$	246	346	22	0.5	100	57	2	0.5	100	59	100
$n = 8$	S.D.	20	20	0.1	0.04	0	21	0.12	0.04	0	20	–
	S.E.	8	7	0.05	0.01	0	7	0.04	0.02	0	7	–

A. Weight of Epididymis

No significant changes in weight was noted in the contralateral epididymis of any of the groups after 3 months, whether ligated for 3 h, for 24 h or not at all.

On the other hand ligated epididymes atrophied:

a. Ligation for 3 h and release of ligature provoked an atrophy in 3 months to 0.3 ± 0.2 g (group 3), while in the control (group 7) it remained 0.5 ± 0.01 g.

b. Ligation for 24 h and release provoked a complete atrophy for the epididymis in three months (group 5), and no epididymal tissue was found.

c. Ligation for 3 h and orchiectomy (group 4) and ligation for 24 h and orchiectomy (group 6) resulted in an atrophy, but to a lesser degree (0.3 ± 0.04 g and 0.3 ± 0.03 g, respectively).

B. Weight of Testis

No significant loss of weight was noted after 3 months in the contralateral testes.

Testes ligated for 24 h atrophied completely and no testicular tissue was found at three months (group 5). A significant atrophy was observed also, but to a lesser degree, in testes ligated for 3 h – their weight after 3 months was 0.4 ± 0.6 g (group 3), while in the control group it remained 2.0 ± 0.05 g.

This loss of weight appeared very quickly, since it was observed already in testes ligated and resected after 3 and 24 h (group 4 and 6) – 1.2 ± 0.06 g and 0.9 ± 0.6 g respectively (control groups 1.2 ± 0.04 and 1.2 ± 0.05 g).

C. Sperm Motility

A decrease of 30% ± 8 in sperm motility was observed in those testes which were ligated for 3 h and castrated, and even more so in those ligated for 24 h (4% ± 4.2). In those ligated but castrated after 3 months, sperm motility was reduced to zero (whether after 3 hours or 24 h).

A reduction in sperm motility, not statistically significant ($p = 0.1$) was noted in the contralateral testes of group 5 (ligation for 24 h and castration after 3 months) – mean of 8 1%. In group 3, testes ligated for 3 h and released, there was no reduction in sperm motility in the contralateral testis after 3 months.

D. Sperm Concentration

No significant reduction of sperm concentration was noted in any of the contralateral testes of any group.

A significant decrease was observed in sperm concentration after ligation for 24 h – 2.4 ± 0.9. No decrease was noted after ligation for 3 h only – 20 ± 7 (control group 1 28.5 ± 4.6 and group 2 26 ± 5).

In ligated testes which were castrated after 3 months, sperm concentration was reduced to zero (control group 7 – 57 · 10^6/cc).

E. Fertility

Ligation of the cord for 3 h and release (group 3) reduced fertility after 3 months to 63% in spite of the viability of the testes. Ligation for 24 h and release (group 5) reduced fertility to zero.

On the other hand, no significant decrease in fertility rate was observed in rats whose damaged testes were resected – group 4: 70%, group 6: 86% of pregnancies.

Discussion

The standard treatment of acute torsion usually includes detorsion of the affected side and bilateral orchiopexy [5].

The rate of testicular salvage after torsion varies according to the authors from 69% [16] to 42% [14], or only 10% [1]. A total testicular torsion is fully reversible after 1 h in all cases and after 2 h in 40% of the cases. The Sertolli cells are destroyed after 6 h and the Leydig cells after 10 h [11]. Klinger [9] claimed testicular salvage up to 5 days after the onset of torsion. Anyhow, a torted testis is doomed to subsequent atrophy in a high percentage of cases [18].

We compared 3 h ligation to 24 h ligation, corresponding to a viable and non-viable torted testis [15].

The period of 3 months was decided upon in order to be sure to eliminate the possibility of reversible fluctuations in spermatogenesis. Sham operations showed a decrease in spermatogenesis leading to the lowest sperm counts on the 17th postoperative day, with full recuperation on the 50th day [6, 12].

Our results parallel those observed by others concerning the ligated testes. Ligation for 3 h (viable testis) results in a certain atrophy of the testis and epididymis, reduces sperm motility to 30% and sperm concentration to a significant degree. A complete atrophy is observed in non-viable testes (ligation for 24 h). Yet some authors advocate orchiopexy in any case denying complications [13] and because of possible viability of the Leydig cells in spite of testicular necrosis [7, 13, 17]. Smith proved that there is a definite correlation between the length of arterial occlusion and the amount of testicular injury sustained. He did not mention the fate of the ipsilateral testis [15]. Jhunjhunwala et al. [7] proved the maintenance of hormonal and even spermatogenic function in the visibly damaged testis. Ludwig et al. [11] denied contralateral changes, while Chakraborty et al. [5] showed morphological abnormalities in the contralateral testis. No one considered fertility as a parameter except Bartsch et al. [2] who found in three patients sperm analyses normal when orchiectomy was performed, while in four patients sperm analyses were pathological when detorsion and contralateral fixation were done more than 24 h after torsion.

We agree with those who claim that orchiectomy is the only course to adopt [4, 7, 8, 17], either because of ipsilateral complications [3, 18] or because it might affect the contralateral testis [3, 5, 10].

What is striking in our experimental work is the fate of fertility in the different groups. No significant decrease in fertility rate was observed in rats whose ligated testes where immediately removed. On the other hand, leaving the ligated testis for three months, whether viable (3 h) or not (24 h) reduced fertility to 63% and 0% respectively. There is a noxious effect of unknown cause produced by the damaged testis. This noxious effect affects mainly fertility, and to some lesser extent the sperm motility. Woodhead et al. [19] denied an influence of an abnormal contralateral testis, but they considered cryptorchism in their paper.

We would suggest that no viable torted testes, although not endangering the ipsilateral hemiscrotum, should nevertheless be removed in order to prevent a damage in the contralateral testis, probably by discharge of antitesticular antibodies [3] or another unknown mechanism.

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