METHODS

Results of Plastic Repair of a Fragment of the Deferent Duct by Autovenous Prosthesis

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Plastic repair of a part of the deferent duct by a segment of autovein in a chronic experiment results in the formation of internal spermatogranuloma, which starts forming at the site of the epididymal anastomosis from days 5-7 and is completely formed by days 17-20 postoperation. These changes determine the negative outcome of the operation: obturation of the deferent duct. In addition, the pathological process (fibrous degeneration of autovenous prosthesis) progresses 30 days after the intervention.

Key Words: *deferent duct plasty; autovenous prosthesis; spermatogranuloma; anastomosis; obturation*

Posttesticular obturation forms of sterility lead to male infertility in 3.0-7.4% cases and are caused by the deferent duct obstruction and, as a rule, spermatogenesis completeness [1-3,7). Iatrogenic injuries to the deferent duct (DD) after technically incorrect inguinal herniotomy belong to the most severe forms of obturation infertility [2]. Therefore, search for plastic material for replacement of long DD defects and basic experimental validation of the operation method is an important problem.

We evaluated the results of plastic repair of a fragment of DD in dogs.

MATERIALS AND METHODS

The study was carried out on 30 healthy dogs (5-30 kg) after a 2-week quarantine in a vivarium. The animals were injected with promedole (30-40 min before surgery subcutaneously, 0.5 ml/kg of 2% solution) and narcotized by 2.5% hexenal or sodium thiopental.

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The skin and subcutaneous fat in the inguinal area were dissected by a vertical incision (5-6 cm). The spermatic cord was mobilized at a length of 5-6 cm, brought to the operation wound, and fixed. The spermatic cord membranes were opened longitudinally on the anterior surface. The deferent duct was mobilized at a length of 5-6 cm and a 3-4 cm fragment was resected with a microsurgical scalpel or razor. The DD vessels were ligated and crossed at the ends of the resected fragment. In case of capillary bleeding from the duct wall, it was arrested by hot saline or aminocaproic acid.

The DD defect was repaired by a free autovenous segment from one of the femoral veins. The skin and subcutaneous fat in the femoral area was dissected along the line of the main femoral vasculo-nervous bundle projection. One of the femoral veins was mobilized at the length of 6-7 cm; its small branches were thoroughly ligated. After ligation of the mobilized fragment in the distal and proximal parts the segment of the vein was crossed and removed. The operation wound was tightly sutured layer-by-layer. The venous prosthesis was thoroughly washed in heparin, put into saline, and

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then used for DD plasty. Anastomoses between the ends of the duct and prosthesis were formed with an atraumatic monofilament thread (7.0) by 6 nodular sutures through all layers of the plastic material and the adventitial muscular part of DD wall. Tantalum wire served as the endoprosthesis; it was removed directly after formation of both anastomoses. The seminal cord membranes were repaired by nodular Capron sutures. The operation wound was sutured tightly layer-by-layer and treated by antiseptic solutions.

The animals were sacrificed with hexenal or sodium thiopental in toxic doses on days 5-7, 10, 17-20, 30, 60-120 days, 6 animals per term.

Chromatoductography, x-ray contrast ductography (injection of Methylene Blue or three-atomic x-ray contrast agent into the DD and neoduct lumen) were carried out. Macroscopic picture of the intervention field, including the anastomoses and autovenous prosthesis, was described; the neoduct and anastomosis zones were studied by the histological method (7-8-μ serial sections, staining by hematoxylin and eosin, by picrofuchsin after Van Gieson, and by resorcine fuchsin after Weigert).

RESULTS

The dogs well tolerated the operation, were active from day 2 postoperation, ate well. Scrotal edema was observed during the first days 2-3 after the intervention and then ceased.

On days 5-7 postoperation the neoduct wall was apparently unchanged in all animals. Anastomoses with the prosthesis (neoduct) were patent, which was confirmed by chromoductography and x-ray contrast ductography.

Loose spermatogranuloma (SG) substance at the site of epididymal anastomosis (EA) were detected in many cases; this substance filled the DD and the neoduct channel near the anastomosis (Fig. 1, *a*). In one case SG was detected on the external surface of DD in the anastomosis zone as a plaque no larger than 0.3×0.6 mm. The testicle and epididymis were apparently unchanged.

Histological studies of serial longitudinal and transverse sections through the neoduct wall and anastomoses showed that by day 5-7 postoperation there were necrotic foci in the muscular part of the wall and zone of erythrocyte imbibition of the wall, and destruction of elastic fibers.

Complete connection between the DD adventitial membrane and autovein was seen in all cases in the vesicular anastomosis (VA) and EA. No transition of the DD wall muscle elements into the autovein wall was noted. An SG, representing foci of spermatozoa, started to form near EA.

On day 10 no macroscopic changes in the neoduct wall were detected in any of the cases. The outer diameters of VA and EA coincided. In two cases an SG (a plaque no larger than 2.0×1.5 mm) was detected on the external surface of EA. No deformations at the site of anastomoses were detected. All VA and 3 of 6 EA were patent. The DD

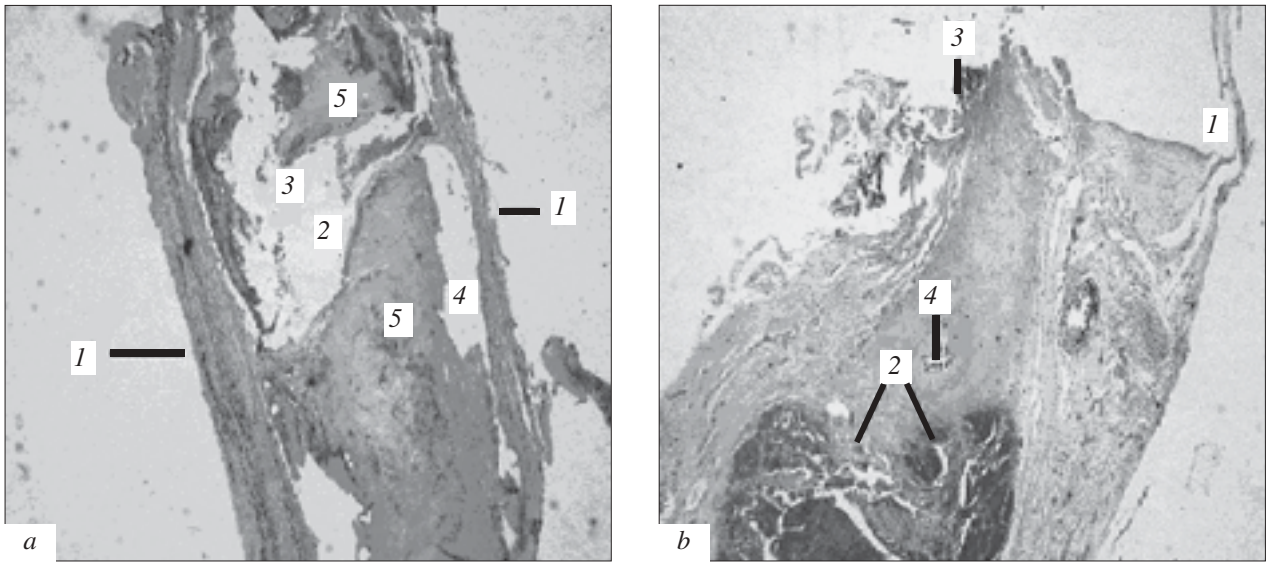

Fig. 1. DD EA zone with autovenous prosthesis on days 6 (*a*) and 17 (*b*) after the intervention. Hematoxylin and eosin staining, ×52. *a*) clearly seen venous prosthesis walls (*1*); prosthesis lumen divided in the middle (*2*) into upper (*3*) and lower cavities with a valve (*4*), connecting the two walls with a continuous cord; the cavities contain conglomerations of spermatozoa (*5*). *b*: site of DD and prosthesis anastomosis (*1*): SG (*2*) seen near the duct; surgical thread cuts into the prosthesis lumen (*3*); DD lumen (*4*).

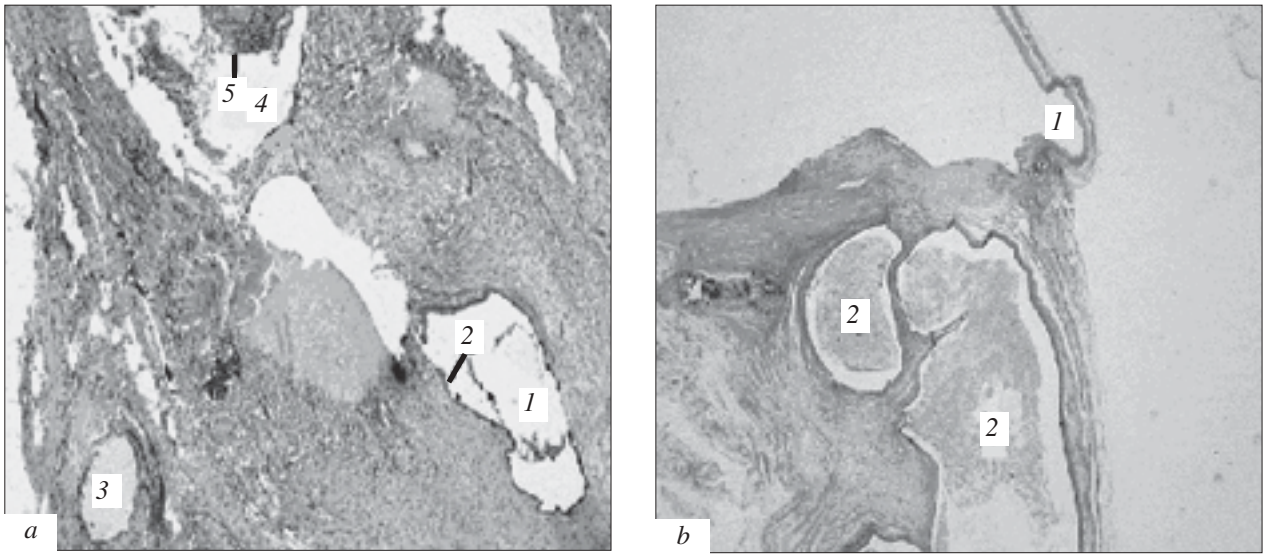

Fig. 2. DD VA zone with autovenous prosthesis on days 10 (*a*) and 120 (*b*) postoperation. *a*) site of DD wall anastomosis with venous prosthesis; DD lumen (*1*) lined by epithelium (*2*), surgical thread is seen (*3*); conglomerations of spermatozoa (*5*) are seen in the neoduct lumen (*4*). *b*: anastomosis of DD wall with prosthesis wall, looking like a branched process (*1*), the duct lumen is dilated and contains spermatozoa (*2*). Hematoxylin and eosin staining, ×105 (*a*), ×52 (*b*).

and neoduct channels in the zone of 3 obstructed EA were filled with compact crumbling SG. In three other cases the DD channel in the EA zone was filled with loose SG and the anastomoses still remained patent.

The DD and neoduct lumens in the VA zone were empty in all cases. After a retrograde injection of indigocarmine solution into the DD channel the stain appeared in the neoduct lumen. The anastomoses were patent.

The number of elastic fibers in the autovenous segment wall decreased significantly. Examination of serial sections through anastomoses showed that the DD and neoduct lumen in the EA zone was filled with SG. SG detached the DD epithelium from the underlying tissue in 2 of 3 obstructed anastomoses.

The DD and neoduct lumen was empty in the VA zone. DD epithelial cells were seen on the inner surface of the autovein (Fig. 2, *a*).

On days 17-20 no apparent changes in the autovein wall were seen in any of the cases. The diameter of the DD epididymal fragment was greater than the diameter of its vesical fragment. The channel of the DD epididymal fragment and epididymal tubule were dilated.

All EA were obstructed. Compact SG, obstructing the neoduct channel in the DD in the EA zone, was seen in the autovein lumen at the site of anastomosis (Fig. 1, *b*). VA were patent.

The histological picture of the neoduct wall indicated a drastic decrease in the content of elastic fibers and even their complete disappearance in both anastomoses zones, where the neoduct wall was represented mainly by connective tissue. The DD lumen in the EA zone was formed by forming SG. No epithelium was detected on the DD wall in the anastomosis zone. The histological picture in the VA zone corresponded to the picture observed on day 10 after the operation.

TABLE 1. DD Anastomoses with Autovenous Segment (*n*=6)

Day of observation	EA		SG		VA		SG	
	patency	obstruction	outside	inside	patency	obstruction	outside	inside
5-7	6	—	1	5	6	—	—	—
10	3	3	2	6	6	—	—	—
17-20	—	6	—	6	6	—	—	—
30	—	6	1	5	3	3	—	3
60-120	—	6	3	6	3	3	—	3

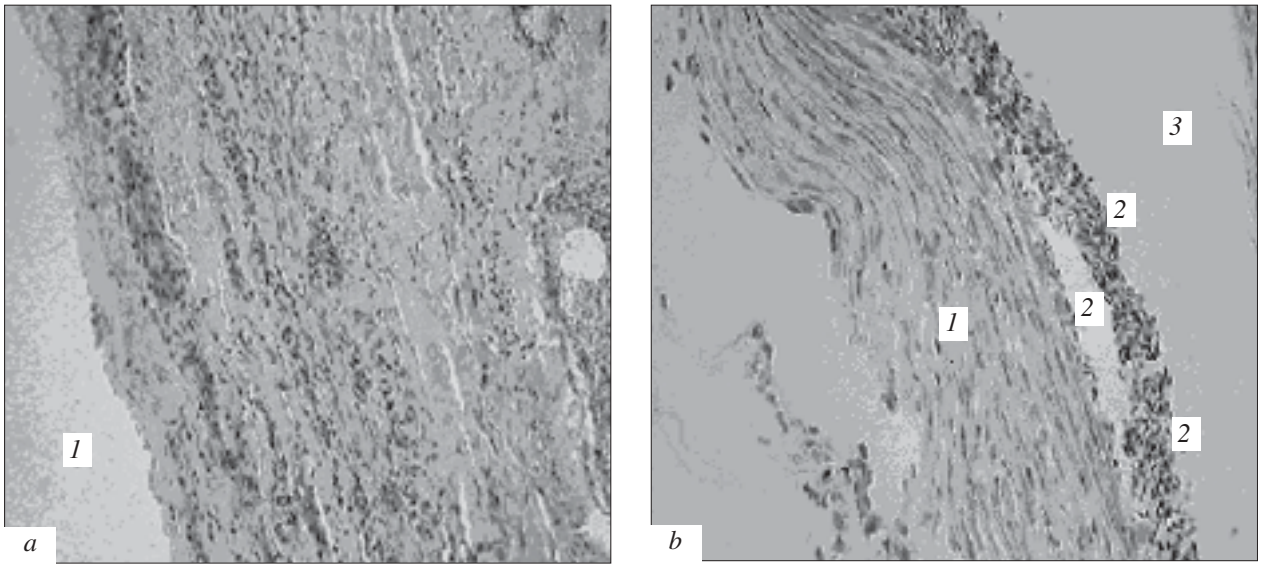

Fig. 3. Structure of autovenous prosthesis wall on day 30 (*a*) and of the neoduct on day 120 (*b*) postoperation. *a*: autovenous prosthesis wall in the outer compartment consists of young fibroblast-like cells. The neoduct lumen (*1*). *b*: neoduct wall consists of connective tissue (*1*) and is covered by a thick layer of spermatozoa from the inner surface (*2*). Neoduct lumen (*3*). The picture indicates complete anastomotic connection of the prosthesis to DD. Hematoxylin and eosin staining, ×420 (*a*), ×850 (*b*).

On day 30 condensation of the neoduct wall was noted in all the cases. Its channel was filled with yellowish crumbling SG. The diameter of the DD epididymal fragment was significantly greater than the diameter of its vesical fragment. The epididymal tubule and channel of the DD epididymal fragment were significantly dilated in all cases. Antegrade ductography could not be performed. VA was patent in 3 of 6 cases. Microscopic examination of the neoduct showed that its wall consisted mainly from connective tissue with few smooth-muscle elements (Fig. 3). No elastic fibers were detected in the autovein wall. The DD and neoduct channel in the EA zone was filled with SG with foci of connective tissue.

The neoduct channel in the VA area was optically empty in 3 cases and in 2 cases was filled with forming SG.

On days 60-120 the macroscopic and histological picture of the plastic material and anastomoses corresponded to the picture observed on day 30 after the operation (Fig. 2, *b*).

Hence, macroscopically the picture of the neoduct remained unchanged till day 20 postoperation and only by day 30 its condensation was noted. Microscopic changes of the autovein wall were noted earlier and on days 5-7 postoperation were represented by foci of muscular wall necrosis and zones of the wall imbibition by erythrocytes. By days 17-20 postoperation disorganizatioon of elastic fibers and decrease in their number were noted. Blood vessels appeared in the neoduct wall. Venous wall was replaced by connective tissue 30 days after the intervention; just few smooth-muscle elements were retained. The histological picture was retained till days 60-120 after the intervention.

The time course of functional changes in EA and VA was different (Table 1).

The function of VA (but not EA) depended on the presence of SG in its lumen.

Spermatogranuloma was found in all cases, while the patency was retained completely on days 5-7 and in half of cases on day 10. The explanation for this fact was found in histological studies. After 5-7 and 10 days SG was represented by rather loose foci. Its organization started only from days 17-20 postoperation. From this period the seminal liquid could no longer flow through EA.

The emergence of SG on the outer surface of EA was noted in just 20% cases and did not correlate with the term of observation. It seems that SG presence on the duct surface reflects just the primary hermeticity of the anastomosis and does not play the key role in impairment of its patency.

Secondary hermeticity of the anastomosis depends on the regenerative processes, which could be traced starting from days 5-7 postoperation.

By this period the autovein adventitium and DD grew together in the EA and VA zones. The DD epithelium regeneration in the EA and VA zones varied. In VA zone the DD epithelial cells were detected on the inner surface of the neoduct starting from day 10, while in the EA zone no “crawling”

of the duct epithelial cells on the neoduct wall was noted. In many cases the duct epithelium was detached from the underlying forming SG tissue. Transition of the DD wall muscle elements into the autovenous segment wall in the EA and VA zones was noted in all cases by day 10.

Hence, SG forming during the first days after the intervention in the EA zone and necrotic and hemorrhagic foci in the autovein wall prevent the regeneration and "crawling" of the DD epithelium to the neoduct wall, which determines the unfavorable outcome of the operation.

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