Experimental Model of Autotransplantation of the Deferent Duct on an Arterio-Venous Pedicle

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Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 144, No. 10, pp. 476-480, October, 2007
Original article submitted April 2, 2007

Adequate circulation in the transplanted autologous deferent duct can be restored by anastomosing the testicular artery and vein in the transplanted organ with the inferior epigastric vessels on the donor side of the intervention. An obligatory condition to preparation of the graft to transplantation is the presence of the epididymis; under its capsule the arterial and venous arches of the testicle, anastomoses of the terminal portions of the epididymal main vessels (the testicular basin) with the terminal portions of the deferent duct, are located.

Key Words: *autotransplant; deferent duct; testicular arterial arch; testicular venous arch; inferior epigastric vessels*

Azoospermia (the absence of spermatozoa in the ejaculate), caused by combined disease: testicular atrophy (aplasia) and acquired extensive defect of the deferent duct (DD), is a frequent disease in andrology [3]. Attempts at restoration of a part of the DD with silicone tubular prosthesis, autovenous segment [5], and autoprosthesis formed from the vaginal testicular membrane on an arterio-venous pedicle [2] in chronic experiments on laboratory animals were ineffective.

The aim of this study was to develop a method for autotransplantation of the DD on a vascular pedicle, because restoration of adequate circulation in the transplanted organ is an obligatory condition for its acceptance.

MATERIALS AND METHODS

A total of 36 experiments were carried out under conditions of anatomical operation room; the technology of DD autotransplantation was elaborated and the adequacy of circulation in the transplanted organ at the expense of the testicular vascular basin was evaluated.

The advantages of the inferior epigastric artery and vein anastomosed to the respective vessels of the testicular transplant are obvious and were described previously [1,3,4].

The correctness of choice of the testicular vessels for provision of the DD transplant trophics was confirmed by perfusion of the transplant vascular system with stained solutions (functional chromatography). The entire anatomical complexes, including the testis, epididymis with membranes, and all elements of the spermatic cord to the internal opening of the inguinal channel, were resected in male cadavers. The testicular artery (TA) was mobilized in the vascular pedicle; a cannula was inserted into it and connected to the syringe filled with libilene blue. The spermatic fascia and testicular vaginal membranes were opened and carefully removed. After ligature of the testicular vessels in the *rete restis* area and vascular anastomoses between the intraorgan vessels of the epididymis and testis, located at the head and tail, the gonad was removed. The vascular pedicle of the transplant was detached from the DD by carefully ligating the anastomotic branches between the main vascular collectors. The

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0007-4888/07/1444-0591

distal ends of the duct vessels were ligated. After verifying the adequacy of hemostasis the stain was injected into the vascular system of the transplant and filling of its arterial and venous systems and outflow of stained fluid through the testicular vein was registered.

In some cases, X-ray contrast angiography was carried out after chromangiography.

RESULTS

The DD autotransplant was resected on the ipsilateral side.

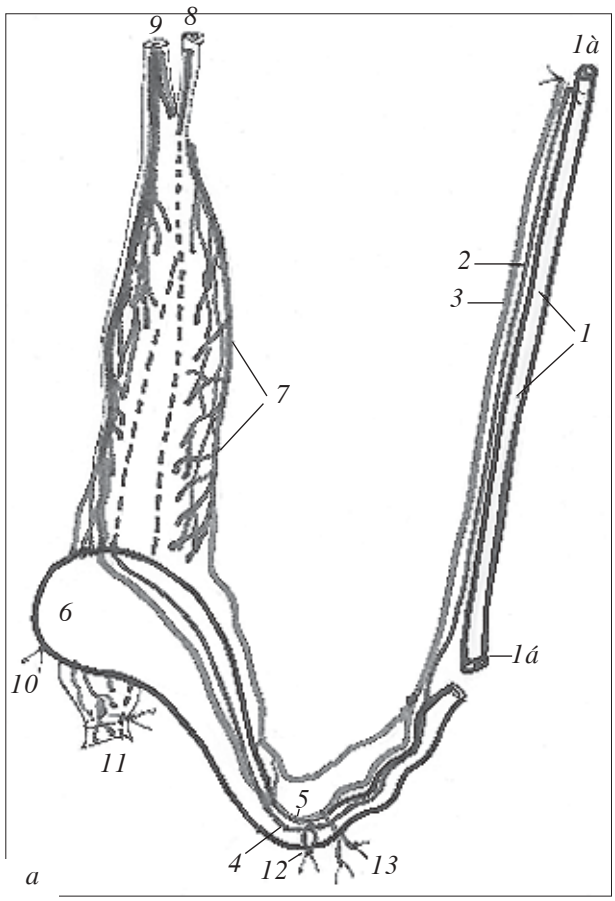
The skin, subcutaneous fat, and the anterior wall of the inguinal channel were dissected by an oblique incision in the inguinal area. The testis was brought out into the operation wound. The testis and spermatic cord were carefully mobilized, so that the membrane was left intact. The inner opening of the inguinal channel was extended with a blunt instrument and the peritoneum was carefully dissected. The TA and testicular vein were mobilized at the lateral pelvic wall and after two proximal ligatures they were resected at a distance of 1.0-1.5 cm from the inner opening of the inguinal channel. DD was mobilized at a length of 1.0-1.5 cm behind the inner opening of the inguinal channel near the entry into the pelvis and resected. The resultant transplant containing the testis, epididymis, and all elements of the spermatic cord with all membranes was placed into the transportation container filled with Collins' solution.

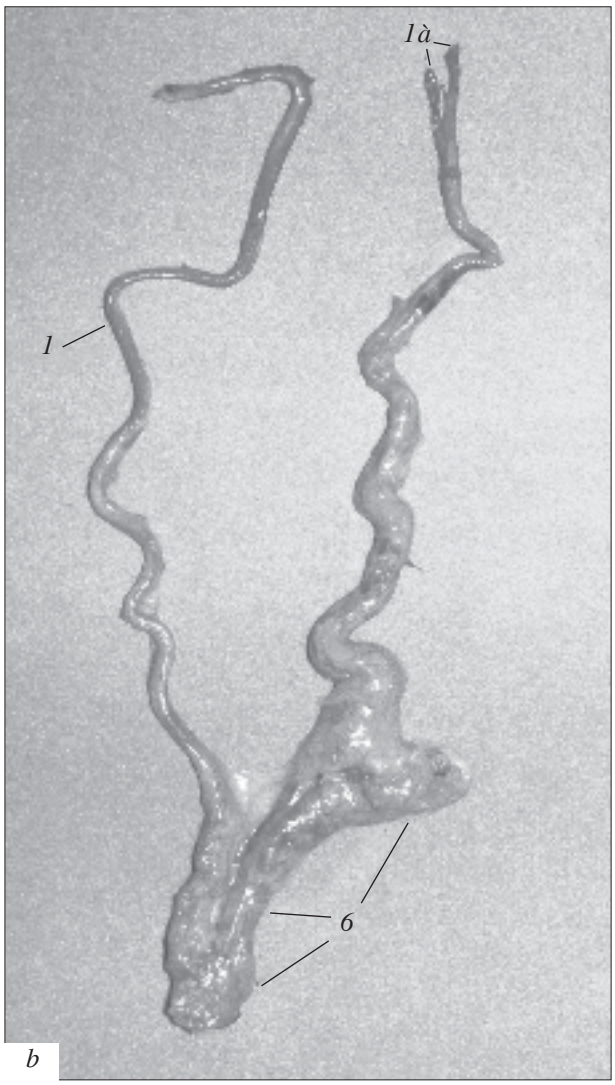
The preparation of the DD transplant was started by opening the outer and inner leaflets of the spermatic fascia and outer and inner testicular membranes. The gonad was removed after preliminary ligature of the TA and pedicles of the pampiniform plexus at the testicular hilus. During removal of the testis special attention was paid to the superior and inferior epididymal ligaments near the epididymal head and in the zone of its tail transition into the twisted portion of DD. The inter-systems anastomotic branches were detected in this latter region in all cases; these branches were subjected to obligatory ligature. The testis was then removed. After removal of the gonad its membranes and spermatic fascia leaflets were resected. The next step was mobilization of the testicular vessels. The TA and testicular veins were as a rule easily identified. If identification was difficult, the following method was used. Like any other arterial trunk, TA has better developed muscular layer, and hence, its wall is thicker. As a rule, the diameters of the venous trunks in this area are greater than the TA diameter. As a rule, TA is located between two venous trunks. If identification of TA among several vessels is impossible, the entire vascular complex should be ligated with a thick ligature proximally from the site of preparation and all tissues distal from the ligature should be resected. In such a case, TA will be the only vessel identified above all fresh-resected tissues of the vascular pedicle. TA was then clamped and the ligature was loosened. TA and one of the veins of the pampiniform plexus were then prepared to anastomosing: they were mobilized from the adjacent tissues to a length of 1 cm and the ends of vessels were fixed with vascular clamps. The preparation of the vessels was finished by this step, if a hand-made vascular suture was planned. If the arterial and venous anastomoses were formed using suturing devices, the adventitia was removed from vessels' ends at a length of 0.5-1.0 mm and the ends were rolled on the suturing device sleeves. Sleeves 1.0-1.2 mm in diameter were used for arterial anastomosis and 1.4-1.8 mm in diameter for venous anastomosis formation.

The vascular pedicle was then separated from DD to the epididymis. For this end, the vascular pedicle and DD were taken with separate holders in the middle of the spermatic cord and brought away from each other to opposite sides. Due to this, the 2nd-level inter-systems communicants were well seen, which were thoroughly ligated. In order to prepare DD terminals to anastomosing, the proximal part of the DD artery was ligated together with the vein. DD was transversely dissected sparing the DD vessels at the site of transition of its twisted part into the straight one (Fig. 1, *a*, *b*).

During functional chromatography, stained fluid at first filled the DD arteries and then the veins, epididymal and plexus pampiniformis veins (Fig. 1, *c*). Hence, the testicular vessels are capable of providing adequate circulation of the transplanted DD through the existing anastomoses between the testicular and DD vessels (Fig. 2).

For the DD autotransplantation on vascular connections, the skin and subcutaneous fat were dissected by an oblique incision in the inguinal area and then the anterior wall of the inguinal channel was dissected. The aponeurosis of the abdominal external oblique muscle was brought upward, the fibers of the abdominal rectal muscle were separated with a blunt instrument, and the inferior epigastric vessels were found in the peritoneal fat and mobilized at a length of 4-5 cm. The peripheral ends of the inferior epigastric artery and accompanying inferior epigastric vein were ligated and crossed proximally from the ligature. Free ends of





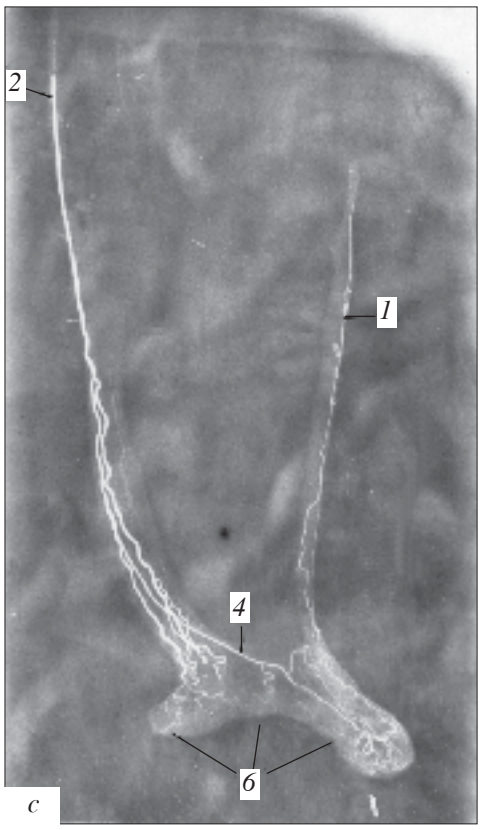


Fig. 1. Deferent duct transplant. *a*) scheme; *b*) photograph; *c*) X-ray contrast angiography. *1*) DD (*1a* and *1b* are the ducts ends, prepared for anastomosing); *2*) DD artery; *3*) DD vein; *4*) testicular arterial and *5*) venous arches; *6*) epididymis; *7*) plexus pampiniformis with TA with its branches inside; *8*) main TA trunk; *9*) testicular vein main trunk; *10*) TA before perforating the tunica albuginea; *11*) testicular venous plexus vessels, originating from the gonad (the testis is removed); *12*) terminal portion of cremasteric artery, participating in formation of inter-systems fusion of testicular arteries; *13*) sources of cremasteric veins, forming IVC.

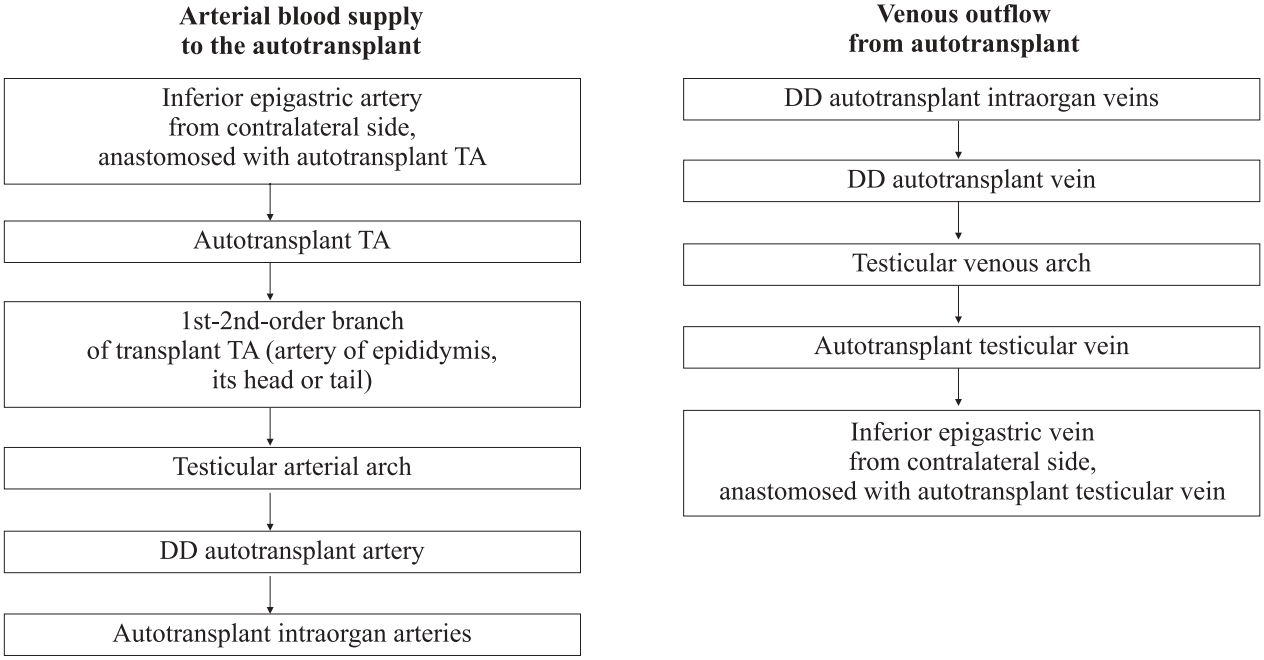


Fig. 2. Schemes of hemodynamics in transplanted DD.

the epigastric vessels were translocated into the inguinal channel and then prepared to anastomosing by the same methods as those used in the treatment of the artery and vein of the transplant vascular pedicle. Vascular anastomoses were formed manually using an atraumatic thread (7/0).

Vascular anastomoses were formed by separate nodular sutures using two holder sutures, first suturing the posterior and then the anterior lip of the anastomosis. A mechanical vascular suture was used in some cases (with a minor vessel-suturing device).

The defect of the deferent system was replaced with the DD transplant. The intact DD in the inguinal compartment was mobilized to the length of the transplant, the ends of the mobilized portion were crossed and the fragment of the duct was removed. The arteries and veins of the remaining parts of the duct were ligated. The DD fragment for transplantation was placed to the site of the formed defect. End-to-end anastomoses between the proximal ends of the "local" duct and the transplant were formed using an atraumatic 7/0-8/0 thread by separate nodular sutures without endoprosthesis (Fig. 3).

The vascular pedicle of the transplant was then carefully (without twisting) positioned in the inguinal channel. The DD plasty was carried out by Martynov's method. The operation wound was sutured layer-by-layer hermetically.

Hence, resection of the tissue complex for DD transplantation on the ipsilateral side is not a problem. As a result of DD autotransplant preparation, a plastic tissue complex is formed, which is easily located in the scrotum and inguinal channel (on the contralateral side).

The proposed autotransplantation of DD on an arterio-venous pedicle is a practically realizable operation in andrology.

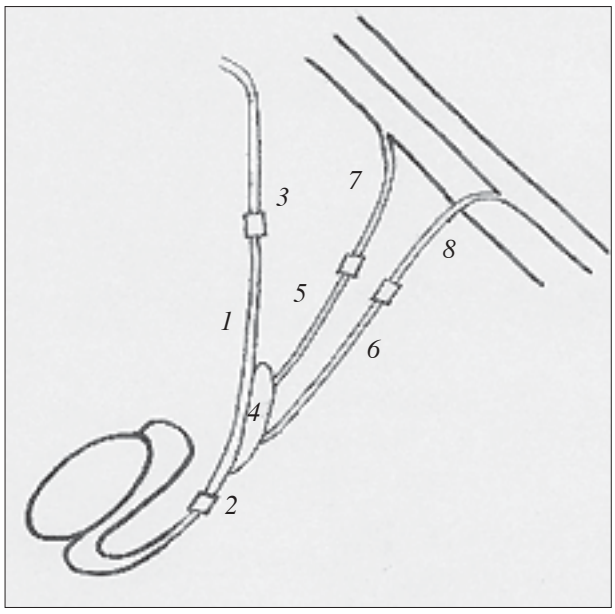


Fig. 3. Scheme of autotransplantation of DD on an arterio-venous pedicle. Resected portion of DD replaced with an autotransplant (*1*), the ends of which are anastomosed with ends of anatomically intact "local" duct (*2* epididymal and *3* vesical vasoanastomoses). Autotransplant includes the epididymis (*4*). Hemodynamics of transplanted duct is maintained due to connection to testicular vessels in the autotransplant (*5* arteries and *6* veins) with mobilized inferior epigastric vessels (*7* artery and *8* vein).

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