Nerve-Sparing Radical Hysterectomy: Kobayashi's Method

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Abstract

After Prof. S. Okabayashi introduced Okabayashi Operation in 1921, several surgeons introduced numerous improvements in Japan. One of them is so-called the Tokyo Method which was improved and revised by Dr. Kyusaku Ogino (1950), Prof. Takashi Kobayashi, University of Tokyo (1961, 1970), and Prof. Shoichi Sakamoto, University of Tokyo (1981). The nerve-sparing radical hysterectomy without sacrificing radicality was introduced in 1961[1] and improved in 1970 by Prof. Kobayashi.[2] The autonomic nerve pathway including hypogastric nerve (sympathetic nerve), pelvic splanchnic nerve (parasympathetic nerve), and pelvic nerve plexus as a junction of the two nerves and the branch of the plexus to the bladder (vesical nerve branch) are preserved except in advanced cases. He divided the process of nerve-sparing surgery into four steps for separating the autonomic nerve pathway from adjacent tissues along the pathway consisting of cardinal, sacrouterine, rectouterine/vaginal, and vesicouterine ligaments. The first step is separation of the cardinal ligament (deep uterine vessels) from the pelvic splanchnic nerve. The second step is separation of the medial side of severed cardinal ligament from the pelvic nerve plexus. The first and second steps are performed in the lateral side of the autonomic nerve system. The third step is separation of sacrouterine and rectouterine/vaginal ligaments from hypogastric nerve and pelvic nerve plexus. The third step is necessary for achieving high radicality, namely, for severing the sacrouterine and rectouterine/vaginal ligaments near the rectum without damage to the pelvic nerve plexus. The fourth step is separation of paravaginal tissues and posterior (deep) layer of the vesicouterine ligament from the vesical nerve branches of the plexus. The third and fourth steps are performed in the medial side of the autonomic nerve system.

Keywords

- cervical cancer
- nerve-sparing radical hysterectomy
- hypogastric nerve
- pelvic splanchnic nerve
- pelvic nerve plexus

Preoperative Evaluation and Imaging

Patients should not be older than 72 years of age and the lesion should be, by the International Federation of Gynecology and Obstetrics classification, Stage IB1, Stage IB2, Stage IIA1, or Stage IIA2.

Surgical Steps

1. Incision of abdominal wall.
2. Preliminary openin,g of paravesical and pararectal spaces.
3. Pelvic lymphadenectomy.

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4. Dissection of the cardinal ligament.
5. Dissection of the sacrouterine and rectovaginal ligaments.
6. Dissection of vesicouterine ligament.
7. Cutting of vagina and paracolpium.
8. Closure of abdominal wall.

In-Depth Explanation

Positioning of the Team

The surgeon, if right-handed, begins the operation standing on the right side of the patient and maintains this position until the left cardinal ligament is severed. He then shifts to the left side of the patients and continues the operation until its completion.

Special Instruments

The following instruments have been specially designed for the operation. Self-retaining retractor with a third rubber blade, rectum retractor, bladder retractor, right angled retractor, ureter hook, horizontally curved forceps, and membrane forceps.

1. Incision of abdominal wall and pelvic peritoneum

The abdomen is opened through a midline incision extending from the mons veneris to above the umbilicus. The specially designed self-retaining retractor is particularly useful in major gynecological operation such as radical hysterectomy.

Kocher's forceps with long, straight jaws are applied to the round ligament and the fallopian tube, on each side, close to the uterus to hold it and to prevent the spreading of cancer cells. It is advisable to cut the round ligament before the infundibulopelvic ligaments as it enables a better direct view of the ureter and its direction.

After the peritoneum of the vesicouterine pouch is incised, the anterior peritoneal flap is sutured to the abdominal wall with one stitch. The bladder is then separated from the cervix as a preliminary to exclude bladder involvement with tumor and so ensure operability.

2. Opening of paravesical and pararectal spaces

The paravesical space and pararectal space are opened so that the anatomical relationship between organs in the pelvic cavity can be better determined. The pararectal space can be opened easily by separating the ureter from the pelvic vessels in a medial direction. The space is cleared until the posterior side of the cardinal ligament is seen.

3. Pelvic lymphadenectomy

First, the external iliac vessels are isolated from the psoas muscle and then the pelvic wall is exposed to sufficient depth as to reveal the obturator nerve. Continuing this procedure the entire lengths of both the external iliac artery and vein are laid bare and all the branches of the hypogastric veins are exposed.

Next, the lymph nodes are dissected distally along the pelvic wall in the order shown. A recommended technique for removal of nodes is to dissect the perivascular sheet from the vessels, lifting the nodes with the sheet by membrane forceps, and pressing down the vessels at the same time by means of a swab or scissors. The pelvic lymph vessels converge to a main trunk at the common iliac vessels.

The order of dissection is common iliac nodes followed by external iliac nodes. The lymph nodes are isolated together with the perivascular sheet. The upper end of the common iliac node is picked up and the main lymph trunk is then clamped. The common iliac lymph nodes should be removed carefully on their deep aspect, protecting the venous wall.

Now the order becomes lateral suprainguinal nodes followed by medial suprainguinal nodes. After dissecting the external iliac nodes, the retractor is raised to permit removal of the suprainguinal nodes. First, the lateral part of these nodes is removed, then the medial part. Care should be taken not to damage the inferior epigastric vein at this time. The medial suprainguinal nodes are removed to a point where the periosteum is exposed. Extreme care should be taken not to damage the innominate vein communication between the external iliac vein and the obturator vein.

Next, the obturator nodes are dissected followed by the internal iliac nodes. Since the lateral part of the node mass has already been completely isolated from the pelvic wall, the nodes can be removed from the surface of the cardinal ligament. The nodes can be removed easily only in this way. When removing the obturator nodes, the obliterated umbilical artery is exposed. This facilitates the following part of the operation. If the sacral nodes are enlarged, they are also cleared.

The obliterated umbilical artery is lifted up and the uterine artery is isolated. Double ligatures are then applied and the artery is severed between ligatures. About 5 cm of thread are left on the side of the uterus as a marker.

The ureter is isolated from the posterior leaf of the broad ligament. The ureter enters the tunnel which is formed between the anterior and posterior layers of the vesicouterine ligament.

• Tips and Warnings

To dissect pelvic lymph nodes completely, it is important to remove the internal iliac (hypogastric) nodes around the superior gluteal vein and the obturator nodes on the psoas muscle.

4. Dissection of cardinal ligament (►**Figs. 1**, **2** and **9**)

In the left side, the paravesical space is opened. Insert the right-angled retractor and the rectum retractor into the inlet of the paravesical space to keep the area opened widely. The pararectal space along the surface of the sacral bone is opened by pushing the rectum medially inside the pelvic nerve fibers. The cardinal ligament is now isolated.

The lymph nodes situated on the anterior and posterior surfaces of the cardinal ligament are next dissected. Removal of the lymph nodes at the base of the cardinal ligament is important as a lymph node metastasis frequently occurs here.

At this stage the blood vessels in the cardinal ligament are dealt with. If there is a blood vessel running independently, it

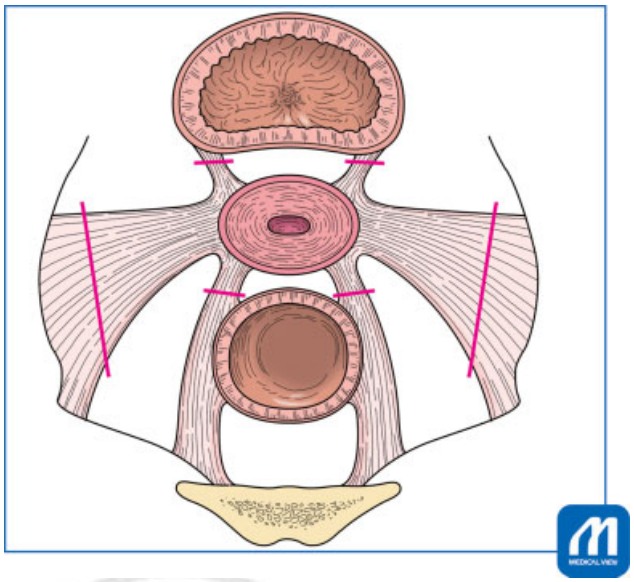

Fig. 1 (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View).

is safer to ligate and sever it separately. Forceps are inserted between the two parts of the cardinal ligament. The upper soft part is the vascular part, and the lower hard bundle contains the autonomic nerve.

Two Kocher's forceps are applied to the vascular part, one outside and the other inside the ureter. The cardinal ligament is cut between the forceps. The stump on the lateral side is ligated with thread. Operation on the left side is now complete.

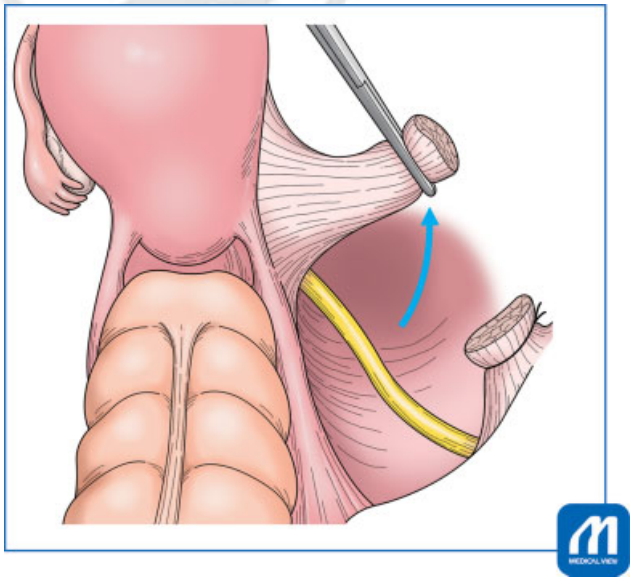

Fig. 2 Second step: Separation of cardinal ligament from pelvic splanchnic nerve and pelvic nerve plexus 2. The second step is separation of the medial side of the severed cardinal ligament from the pelvic splanchnic nerve and pelvic nerve plexus. (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

In similar fashion the surgeon starts by opening the paravesical and pararectal spaces and then proceeds to lymphadenectomy, ligature of right uterine artery, exposure of the right ureter, and dissection of the right cardinal ligament.

5. Dissection of the sacrouterine and rectovaginal ligaments (►**Fig. 1**)

The peritoneum of the Douglas pouch and the posterior leaves of the broad ligament are transversely incised. The vaginal wall is separated from the rectum to a point below the cardinal ligament to permit extirpation of an ample vaginal cuff. To accelerate resumption of normal bladder function after operation it is advisable to preserve the branches of the pelvic nerves supplying the bladder.

Prior to severing the sacrouterine and rectovaginal ligaments, complete mobilization of the vascular part of the cardinal ligament from the nerve tissues should be made.

A sheet of sympathetic nerve fibers is first separated from the lateral surface of the sacrouterine ligament with scissors and can be severed without risk of bleeding. Sheets of tissue containing sympathetic nerve fibers are easily recognized as they run along the rectum.

The branches of the pelvic nerve plexus supplying the uterus are divided, extreme care being taken not to sever the vesical branches. By pushing up the caudal end of the sympathetic nerve plate, the pelvic nerve plexus is usually preserved automatically and no special manipulation is needed.

Two curved forceps are applied to the rectovaginal ligament which is then cut between the forceps and ligated. Sometimes repetition of the procedure is necessary to get as deep a separation as possible. The same procedure is made on the other side.

• Tips and Warnings

The most important idea in Kobayashi's method is that the cutting line of the nerve system is different from that of the sacrouterine and rectovaginal ligaments. Separation of the nerve system from the sacrouterine and rectovaginal ligaments (third step) is mandatory before severing these ligaments and the nerve system.

6. Dissection of vesicouterine ligament (►**Fig. 1**)

The bladder must be separated adequately from the anterior wall of the vagina to the same extent that the rectum is separated from its posterior wall.

First, the ureter is separated from the uterine artery and its entry into both layers (anterior and posterior layers) of the vesicouterine ligament (the so-called tunnel). The ureter is displaced to the lateral side. Curved Pean forceps are inserted into the tunnel. In passing Pean forceps through the tunnel, their tip must be directed medially or they may injure the juxtavesical portion of the ureter. Two horizontally curved forceps are then applied. The part between the forceps in the

anterior layer is cut and ligated. To prevent the kinking of the ureter, it is highly advisable to carry out this procedure in two or three steps.

The ureter is isolated from the surface of the posterior part. It is pushed laterally, widely exposing the posterior layer. With the bladder pressed downward, a triangular-shaped recess surrounded by the bladder, the paracolpium, and the caudal margin of the posterior layer is seen. Curved Pean forceps are next inserted into the recess below the posterior layer of the ligament. After opening the blades of the inserted forceps, two horizontally curved forceps are allied onto the ligament at the part between the opened blades. The part between the forceps in the posterior layer is cut and ligated. At this time, the ureter should be carefully separated laterally so that the forceps can be applied approximately 5 mm from the ureter to avoid damage. Next, posterior part of the vesicouterine ligament is severed and the ureter is completely separated from the vagina and uterus.

• Tips and Warnings

The cranial or upper part of vesical branches exists along the outside of the posterior layer of the vesicouterine ligaments. The fourth step is separation of paracolpium from vesical branches of the pelvic nerve plexus.

7. Cutting of vagina and paracolpium

The bladder is further separated from the vaginal wall and paracolpium (paravaginal tissues) to a required level. The paracolpium of both sides should be cut and ligated as deeply as possible at the level required to protect against vaginal stump recurrence. Utmost care should be taken not to cut any remaining autonomic nerve fibers. The anterior wall of the vagina is cut. The cut end of the vagina is now clamped with Kocher's forceps, and the posterior wall of vagina is incised. Thus, the uterus is completely extirpated. This is followed by closure of the vaginal canal.

• Tips and Warnings

To remove 3 cm long of upper vagina and paravaginal tissues, 3 cm wide of the paravaginal tissues in each side should be cut and ligated.

8. Closure of abdominal wall

Two J-VAC tube drains are inserted into the dead space on each side of the pelvis and brought through the abdominal wall. The abdominal wall is closed to complete the operation.

Nerve-Sparing Methods

The autonomic nerve pathway including the hypogastric nerve (sympathetic nerve), pelvic splanchnic nerve (parasympathetic nerve), and pelvic nerve plexus as a junction of the two nerves and the branches of the plexus to the bladder (vesical nerve branches) are preserved except in advanced cases (►**Figs. 3–7**). The process of nerve-sparing surgery is divided into four steps for separating the autonomic nerve pathway from the adjacent tissues along the pathway

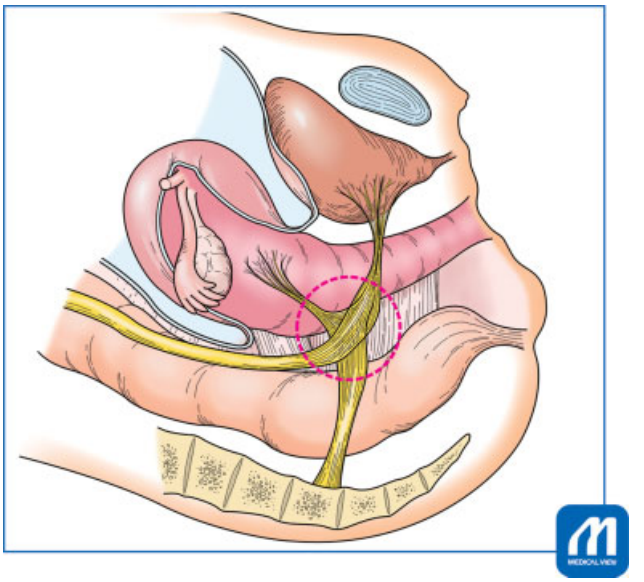

Fig. 3 Autonomic nerve pathway. Figure shows Kobayashi's original figure demonstrating pelvic autonomic nerve pathway in his textbook published in 1970. The autonomic nerve pathway including hypogastric nerve (sympathetic nerve), pelvic splanchnic nerve (parasympathetic nerve), and pelvic nerve plexus as a junction of the two nerves and the branches of the plexus to the uterus and bladder (uterine branch and vesical branches). (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

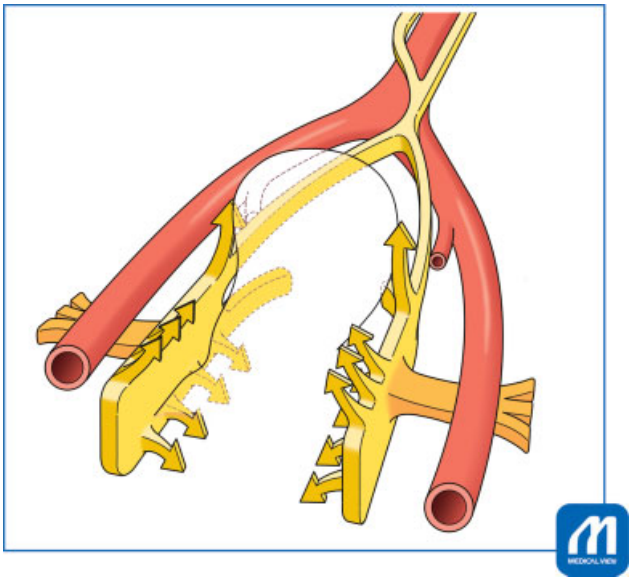

Fig. 4 Autonomic nerve pathway. (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

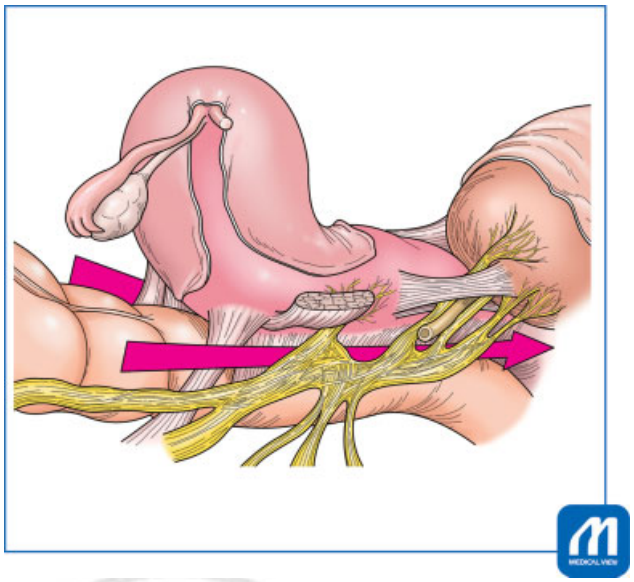

Fig. 5 Third and fourth steps: Separation of sacrouterine and rectovaginal ligaments, and paracolpium from hypogastric nerve, pelvic nerve plexus, and vesical branches. The third step is separation of sacrouterine and vaginal ligaments from hypogastric nerve and pelvic nerve plexus. The third step is necessary for achieving high radicality for severing the sacrouterine and rectovaginal ligaments near the rectum without damage to the pelvic nerve pathway. The fourth step is separation of paracolpium from vesical branches of the pelvic nerve plexus. The cranial part of vesical branches exists along the outside of the posterior layer of the vesicouterine ligaments. (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

consisting of cardinal, sacrouterine, rectouterine/rectovaginal, and vesicouterine ligaments.

First step: Separation of the cardinal ligament (deep uterine vessels) from the pelvic splanchnic nerve (►**Figs. 8** and **9**).

Second step: Separation of the medial side of the severed cardinal ligament from the pelvic splanchnic nerve and the pelvic nerve plexus (►**Figs. 2**, **8**, and **10**). The first and second steps are performed in the lateral side of the autonomic nerve system.

Third step: Separation of sacrouterine and rectouterine/rectovaginal ligaments from hypogastric nerve and pelvic nerve plexus (►**Figs. 5**, **8**, and **10**). The third step is necessary for achieving high radicality, namely, for severing the sacrouterine and rectouterine/rectovaginal ligaments near the rectum without damage to pelvic nerve plexus.

Fourth step: Separation of paravaginal tissues (paracolpium) and posterior (deep) layer of the vesicouterine ligament from the vesical nerve branches of the plexus (►**Figs. 5**, **8**, and **10**). The third and fourth steps are performed in the medial side of the autonomic nerve system.

In ►**Figs. 6** and **7**, the blue boxes indicate the connective tissues consisting of sacrouterine and rectovaginal ligaments and paracolpium. The yellow boxes indicate autonomic nerve pathway including hypogastric nerve, pelvic splanchnic nerve, pelvic nerve plexus, uterine branch, and vesical branches.

The red lines show the cutting lines of the connective tissues and the nerve system in original Okabayashi operation (►**Fig. 6**). The cutting line of the nerve system is in

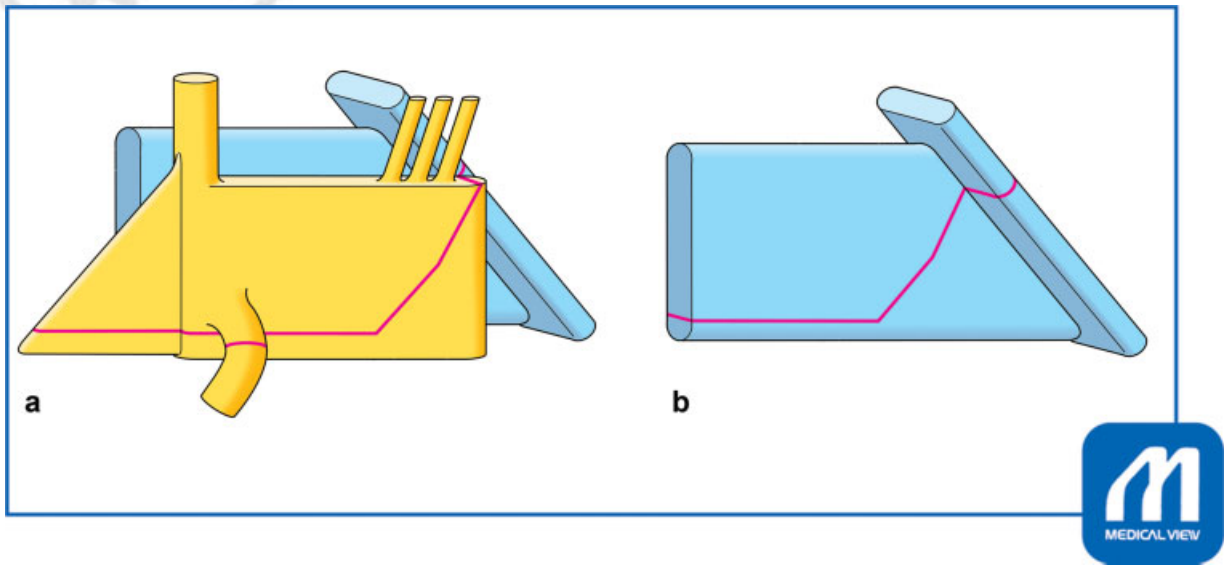

Fig. 6 Original Okabayashi operation. In the figure, the blue boxes indicate the connective tissues consisting of sacrouterine and rectovaginal ligaments and paracolpium. The yellow boxes indicate autonomic nerve pathway including hypogastric nerve, pelvic splanchnic nerve, pelvic nerve plexus, uterine branch, and vesical branches. The red lines show the cutting lines of the connective tissues and the nerve system in original Okabayashi operation. The cutting line of the nerve system is in common with that of the sacrouterine and rectovaginal ligaments. (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

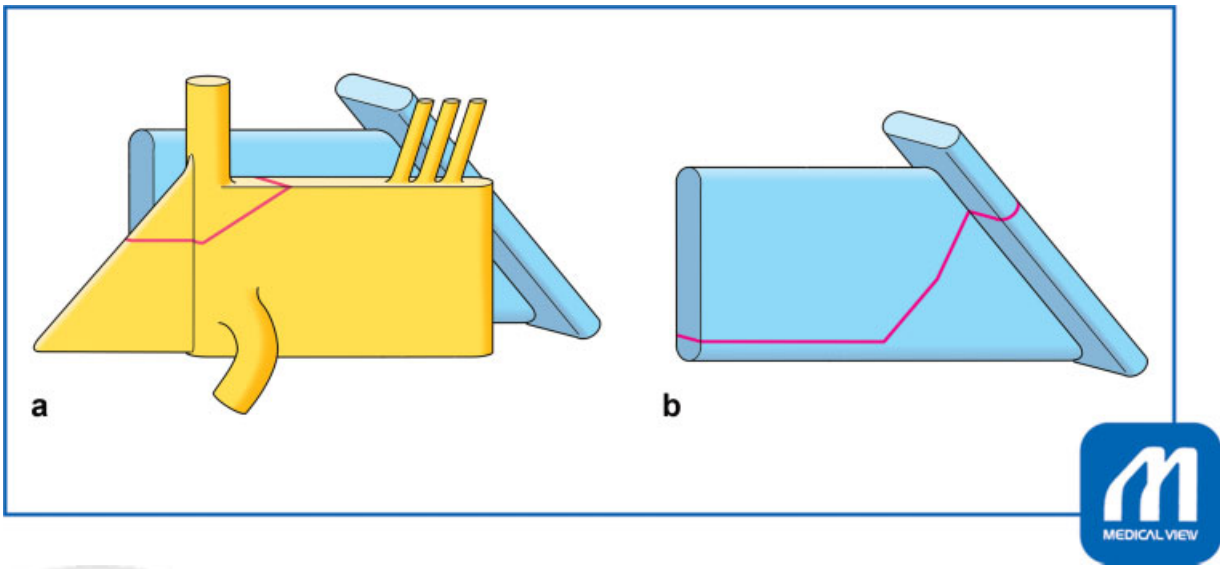

Fig. 7 Kobayashi's nerve-sparing method. The cutting line of the nerve system is completely different from that of the connective tissues in Kobayashi's nerve-sparing method. The most important idea in this method is that the cutting line of the connective tissues is conserved in comparison with original Okabayashi operation without damage to the pelvic nerve pathway. Separation of the nerve system from the sacrouterine and rectovaginal ligaments is mandatory for the purpose of this method. (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

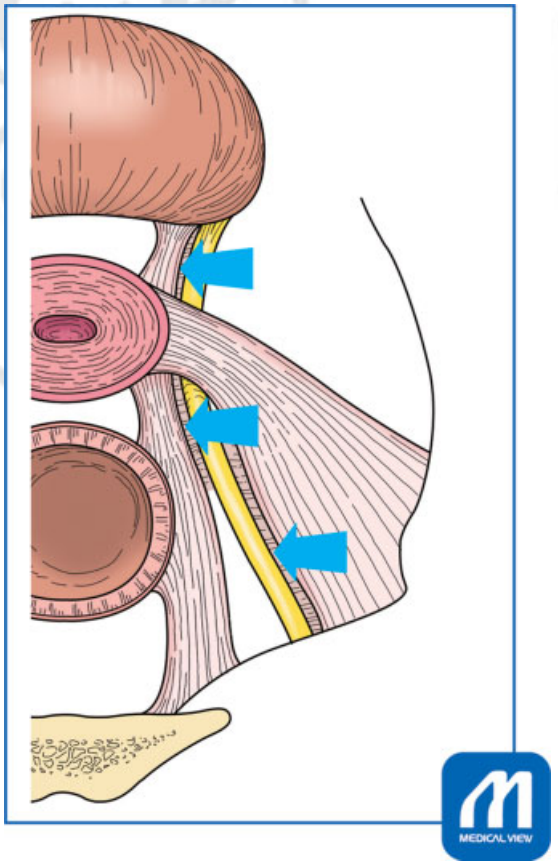

Fig. 8 Autonomic nerve pathway before separation from the adjacent ligaments. This figure shows autonomic nerve pathway before separation from the adjacent ligaments. (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

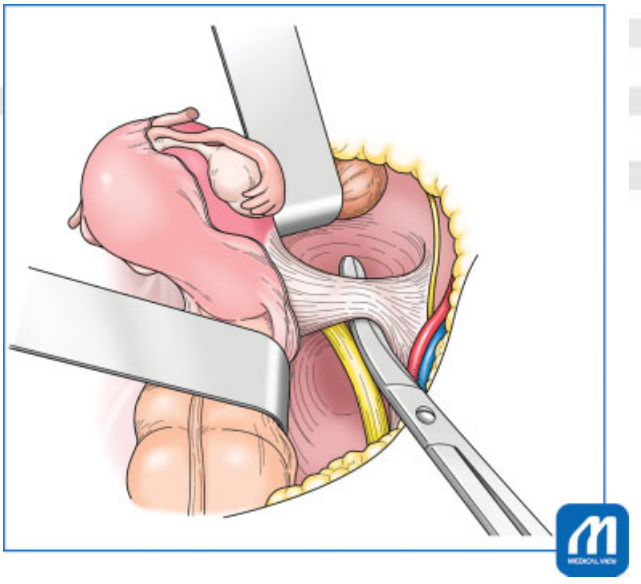

Fig. 9 First step: Separation of cardinal ligament from pelvic splanchnic nerve 2. The first step is separation of the cardinal ligament from the pelvic splanchnic nerve. (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

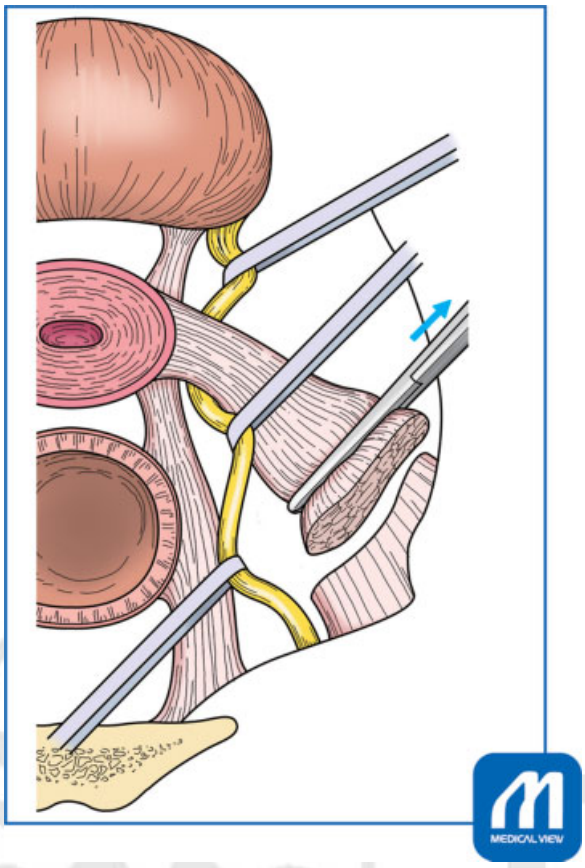

Fig. 10 Autonomic nerve pathway after separation from adjacent ligaments. This figure shows autonomic nerve pathway after separation from the adjacent ligaments. (Reproduced with permission from Yoshikawa H. In: Konishi I, Hiramatsu Y, Sakuragi N, Takeda S, eds. OGS NOW, No.5. (Japanese). Tokyo: Medical View; 2011:46–55. Copyright © Medical View.)

common with that of the sacrouterine and rectovaginal ligaments.

The red lines show the cutting lines of the connective tissues, red boxes, and the nerve system, yellow boxes, in Kobayashi's nerve-sparing method (►**Fig. 7**). The most important idea in this method is that the cutting line of the nerve system is different from that of the sacrouterine and rectovaginal ligaments. The cutting line of the connective tissues in this method is almost the same with that in Okabayashi operation. Separation of the nerve system from the sacrouterine and rectovaginal ligaments is mandatory before severing these ligaments and the nerve system.

Conflict of Interest
None declared.

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