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## REVIEW

# Gastro-intestinal surgery and fertility

T. Hor

*Service de chirurgie digestive, hôpital Saint-Antoine, 184, rue du Faubourg-Saint-Antoine, 75012 Paris, France*

### KEYWORDS

Fertility;  
Chronic digestive  
diseases;  
Digestive surgery

**Summary** In France, 10 to 15% of couples in the overall population have a fertility problem. Preservation of sexual and reproductive function should be a major concern for all patients capable of procreation who undergo treatment for gastro-intestinal disease. The gastro-intestinal diseases most often responsible for fertility disorders include chronic inflammatory diseases, intestinal cancer and hereditary diseases, such as the Lynch syndrome and familial adenomatous polyposis. Obesity is responsible for a 20% loss of fertility but the effects of bariatric surgery on fertility are controversial. Nonetheless, in the light of progress in surgical techniques and better knowledge of gastro-intestinal disease the negative impact of surgery on fertility warrants attention. Effectively, fertility can be preserved after certain major gastro-intestinal operations such as cytoreductive surgery with intraperitoneal chemotherapy, total colectomy with ileo-anal anastomosis and rectosigmoid resection, as long as the patient's age permits and resection of the reproductive organs is not necessary.

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## Introduction

In France, 10 to 15% of couples in the overall population are thought to have a fertility problem. Gastro-intestinal diseases, by their presence or by the treatments that they imply, can exacerbate this rate. Preservation of sexual and reproductive function should be a major concern for all patients capable of procreation and treated for gastro-intestinal disease.

Gastro-intestinal diseases most often responsible for fertility disorders include chronic inflammatory diseases, intestinal cancer, acute inflammatory disease (diverticulitis) and hereditary diseases, such as the Lynch syndrome and familial adenomatous polyposis (FAP). Obesity should now be added to the list.

Therapy required for management of these diseases, including surgery and medical treatment by radiation and chemotherapy can alter reproductive function and consequently the quality of life of these patients. The causes of these disturbances are multiple and are often associated: iatrogenic hormonal deficiencies, erectile and ejaculatory disorders, dyspareunia in women, libido disorders, body image-related disorders, depressive syndrome related to learning about one's cancer or chronic disease, or its prognosis, and the fear of transmission of hereditary genetic disease. Surgery in itself can be responsible for sexual disorders and decreased fertility, e.g., trauma to pelvic nerves or post-surgical anatomical obstruction of the fallopian tubes or adhesions after proctectomy. In the light of progress in surgical techniques such as the development of minimal access (laparoscopic) and robotic techniques and better knowledge of gastro-intestinal disease, the negative impact of surgery on fertility warrants attention.

E-mail address: [theyv.hor@aphp.fr](mailto:theyv.hor@aphp.fr)

<https://doi.org/10.1016/j.jviscsurg.2018.04.006>  
1878-7886/© 2018 Published by Elsevier Masson SAS.

Please cite this article in press as: Hor T. Gastro-intestinal surgery and fertility. Journal of Visceral Surgery (2018), <https://doi.org/10.1016/j.jviscsurg.2018.04.006>

Once gastro-intestinal disease has been cured, the possibility of becoming a parent may become an essential element of acceptable quality of life. Therefore, preservation of fertility remains a concern for patients, their families and health care teams.

The goal of this update is to determine the impact of obesity and colonic disease, whether benign or malignant, hereditary or not, as well as their surgical treatment on sexuality and fertility.

## Rectal cancer

Rectosigmoid resection performed for rectal cancer is a typical example of how surgery impacts fertility. Postoperative reduced fertility could be explained by anatomical modifications after proctectomy. Sexual problems after surgery for rectal cancer are common, multifactorial, insufficiently discussed and they often remain untreated.

In women, the ablation of the posterior wall of the vagina can lead to uterine retroflexion, which in turn, can be responsible for dyspareunia and provoke vaginal dilatation with fluid retention. Several studies have highlighted an increased rate of hydrosalpinx and fallopian obstruction following pelvic surgery [1–3]. Moreover, fallopian tubes are frequently found to adhere to the dorsal pelvic wall in women post-proctectomy [4,5]. Other hypotheses have been elaborated suggesting that pelvic adhesions could complicate the normal passage of the fertilized ovum through the fallopian tube.

Men can also have sexual disorders following proctectomy with total mesorectal excision (TME). Rectal surgery requires understanding the complex anatomy of the pelvic neural pathways because accurate identification of nerves can be difficult because of their size and their proximity to pelvic organs. Nerve lesions can be the result of direct injury or injury to the vascular supply of the nervous system, leading to erectile dysfunction, anejaculation, retrograde ejaculation. In women, neural injuries can result in absence of orgasm, impaired libido and lubrication. Both sexual and urinary function rely on a dual (sympathic and parasympathic) autonomous innervation.

These nerves can be injured at four different levels [6]:

- the superior hypogastric plexus, located anterior to the aorta and pelvic brim, can potentially be injured during rectal mobilization. These lesions can be avoided by respecting the retroperitoneal tissues anterior to the aortic bifurcation and behind the rectum [7];
- the right and left hypogastric nerves can be injured when the lateral perirectal peritoneum is divided. These nerves, arising from the superior hypogastric plexus, are visible 1 or 2 cm medial to the ureter. Prevention consists of identification of these nerves at the level of the aortic bifurcation and incision of the peritoneum as close as possible to the rectum;
- the pelvic plexus and nervi erigentes can be injured during dissection of the lateral rectal attachments. It is necessary to stay in contact with the fascia recti that surround the rectum and its mesentery to avoid injuring these nerves. Identification of the sacral parasympathetic nerves is possible at the level of the S2, S3 and S4 foramina. The nerve that is most exposed is S3 because its anterior arch comes into contact with the lateral ligament structures of the rectum, below the middle hemorrhoidal artery [7];
- lower down, behind the prostate, the nervi erigentes are most vulnerable because of their close contact with the

muscular layer of the rectum. The nervi erigentes arise from the inferior hypogastric nerves that are retroperitoneal, located lateral to the rectum and the medial part is at the apex of the seminal vesicles. The nervi erigentes emerge at the level of the postero-lateral aspect of the base of the prostate and course toward the apex of the prostate along the postero-lateral side of the gland, outside the prostatic capsule and the Denonvilliers fascia on the anterior aspect of the rectum. At the level of the membranous urethra, they are located on the postero-lateral aspect, before coursing through the middle perineal fascia. The ideal plane for anterior dissection is located between the rectal muscular layer and the Denonvilliers fascia that covers the seminal vesicles and the posterior aspect of the prostate.

Thus, the nerves that serve the urogenital area should be preserved if the cancer does not invade the rectal fascia and the inferior mesenteric artery should be ligated at least 1 cm in front of the aorta to limit injury to the superior hypogastric nerve.

While earlier studies have described erectile dysfunction rates as high as 45% in patients undergoing TME and 25% in patients undergoing proctectomy for inflammatory disease [8–10], this rate is lower today because of improved identification of the presacral planes leading to preservation of the hypogastric nerves.

Recent years have seen the development of mini-invasive techniques for rectal surgery such as laparoscopy and more recently robotic surgery. A recent review of the literature [11] comparing laparoscopy to laparotomy, included seven retrospective and two clinical randomized studies (468 laparoscopy vs. 408 laparotomy). No statistically significant difference was found between the two groups concerning ejaculation or erectile disorders, or the overall sexual dysfunction (39% in each group) whether in men or in women. This is similar to the rate of genito-urinary dysfunction that was observed in the Color II randomized trial [12].

Laparoscopy is reputed to offer better preservation of the autonomic nerve system [13,14]. One meta-analysis found that urogenital function was better preserved after robotic rectal surgery [15]; however, there are few studies that have shown any added value for robotic surgery and there are no randomized trials on the subject [13,15,16].

Last, one of the causes of infertility in rectal cancer is associated radiation therapy that can be indicated as neo-adjuvant therapy in these patients. It is important to discuss the deleterious effects of radiation therapy before surgery in women of reproductive age, where ovarian transposition may be indicated.

## Genetic cancers: Lynch syndrome and familial adenomatous polyposis

### Hereditary non-polyposis colorectal cancer (HNPCC) or Lynch syndrome

Colorectal cancers (CRC) related to the HNPCC syndrome represent approximately 5% of all CRCs. They appear around the age of 40 to 50 years, arise more often in the right colon, are mucinous and poorly differentiated and concern one out of 500 to 800 persons. They are transmitted according to a dominant autosomic mode and therefore the risk of transmission is 50% at each pregnancy.

The Lynch syndrome is linked to a mutation of one of the *hMLH1*, *hMSH2*, *hMSH6*, or *hPMS2* genes. These genes make

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