



## ORIGINAL ARTICLE

# Laparoscopic rectal dissection preserves erectile function after ileal pouch–anal anastomosis: a two-centre study

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## Abstract

**Aim:** Few studies have been published on erectile function after ileal pouch–anal anastomosis (IPAA) and, unlike in women, male fertility after IPAA has never been assessed. The primary objective was to assess the impact of IPAA on erectile function. The secondary objective was to assess the impact of IPAA on male fertility.

**Methods:** All of the male patients who underwent IPAA in two university care centres between 2003 and 2017, aged 70 years or less at the time of operation, were included. Forty-eight per cent of the patients responded to the international index of erectile function, the Jorje–Wexner score and a fertility questionnaire. All demographic and perioperative data were prospectively collected. Fertility results were compared with those of a control group undergoing appendectomy, matched for age at the time of operation, desire for paternity and length of follow-up.

**Results:** One hundred and thirty-nine patients were included, among which 46 (33%) presented with erectile dysfunction and 14 (10%) with severe erectile dysfunction. Age older than 50 years (OR 0.27, 95% CI 0.12–0.62,  $P = 0.002$ ) and rectal dissection performed by open surgery (OR 4.16, 95% CI 1.62–10.65,  $P = 0.003$ ) were independent risk factors for erectile dysfunction. There was no infertility after IPAA compared with controls: indeed, 23 (16%) IPAA patients presented with pregnancy in their couple versus 27 (22%) controls ( $P = 0.29$ ), whereas 36 (26%) IPAA patients and 34 (28%) controls ( $P = 0.80$ ) expressed paternity desire.

**Conclusion:** A total laparoscopic approach, including rectal dissection, should be preferred to preserve erectile function. Male fertility is not impaired after IPAA.

## KEYWORDS

ileal pouch–anal anastomosis, proctocolectomy, sexuality, fertility

## INTRODUCTION

Total proctocolectomy (TP) with ileal pouch–anal anastomosis (IPAA) [1] is the surgical gold standard in ulcerative colitis (UC) and

familial adenomatous polyposis (FAP) [2,3]. IPAA may also be applied to other inflammatory bowel diseases (IBDs) in selected cases [4]. In most cases, IPAA is performed for benign diseases, in young patients who are concerned about their sexual function after surgery.

In the case of surgery for rectal cancer, a total mesorectal excision (TME) is indicated, but dissection close to the rectal wall is usually chosen otherwise to reduce the risk of sexual dysfunction. Male sexual dysfunction encompasses mainly erectile dysfunction (ED), but also absence of ejaculation or retrograde ejaculation. Whereas sexual dysfunction has been largely studied after surgery for rectal cancer [5,6], few studies have assessed sexual dysfunction after IPAA [7,8]. Moreover, unlike in women [9,10], no studies have assessed male fertility after IPAA.

The primary objective of the present study was to assess the impact of IPAA on erectile function. The secondary objective was to assess its impact on male fertility.

## METHODS

### Study population

This was a two-centre study conducted in the departments of gastrointestinal surgery of Saint Antoine Hospital (SAH), Paris, and Nord Hospital (NH), Marseille. All consecutive men who underwent IPAA from January 2003 to August 2017, aged 18 years or more at the time of data collection and 70 years or less at the time of operation, were included. Preoperative ED was the only exclusion criterion.

Data were collected from a prospective database. The data included the following: demographic data, such as age at the time of operation and at the time of the study, length of follow-up, body mass index, American Society of Anesthesiology score, medical and surgical history; preoperative data, such as the type of disease (i.e., FAP, UC, other IBD) and indication for surgery (i.e., refractory colitis, rectal stenosis, acute severe colitis, dysplasia, cancer or prophylactic surgery); perioperative data, such as the type of operation (i.e., IPAA in one, two, three stages, or modified two stages), emergency surgery, type of anastomosis (i.e., stapled or hand-sewn), covering loop ileostomy, conversion to open surgery, transfusion and operating time; and postoperative data, such as the length of stay and postoperative morbidity, including anastomotic leakage, extra-pelvic sepsis, ileus and mortality.

### Sexuality and functional outcomes

Patients were asked to answer two full questionnaires by email and short questions during a phone call. To analyse sexual function outcomes, patients answered the international index of erectile function (IIEF-15) questionnaire [11]. Patients were also asked to answer the Jorge-Wexner incontinence questionnaire [12] in order to identify sexual dysfunction related to incontinence. All questionnaires were answered postoperatively. The IIEF-15 questionnaire was associated with a specific quick questionnaire about ejaculation (has it been unchanged or inconstant/decreased since the operation?) and global sexual function (has it been better, unchanged or degraded since the operation?) by phone.

### What does this paper add to the literature?

This study is the first to assess fertility in male after IPAA, which is not impaired. Furthermore, our findings suggest a new benefit of laparoscopic approach in IPAA, namely on preservation of erectile function. Thus, we recommend that the laparoscopic approach should be proposed to men requiring IPAA, along with dissection close to the rectal wall in cases of benign disease.

### Fertility outcomes

Patients were called to answer a fertility questionnaire by phone. The questions asked collected smoking status, socio-educational level, desire for later paternity at the time of surgery, and postoperative data, such as pregnancy attempts, postoperative pregnancy and time to pregnancy. The controls were consecutive men who underwent appendectomy during the same period. These controls were matched for age at the time of operation, for paternity desire and for the length of follow-up. The controls answered the same fertility questionnaire as the IPAA patients by telephone. The shortest time between the questionnaire and surgery was at least 1 year.

### Surgical technique

IPAA could be performed in one, two or three stages, depending on several factors including the emergency or elective status, the type of disease and the clinical context (nutritional status, preoperative therapy). Three-stage IPAA consisted of an initial subtotal colectomy (STC) with an ileo-sigmoidostomy and then a completion proctectomy 3 months later, with IPAA and ileostomy, which was closed 3 months after that. In a standard two-stage procedure a TP with IPAA was performed with a diverting loop ileostomy, and then stoma closure was done. The modified two-stage IPAA consisted of an initial STC followed 3 months later by a completion proctectomy without ileostomy protection [13]. Finally, in the single-stage procedure, TP was associated with IPAA without a diverting loop ileostomy [14].

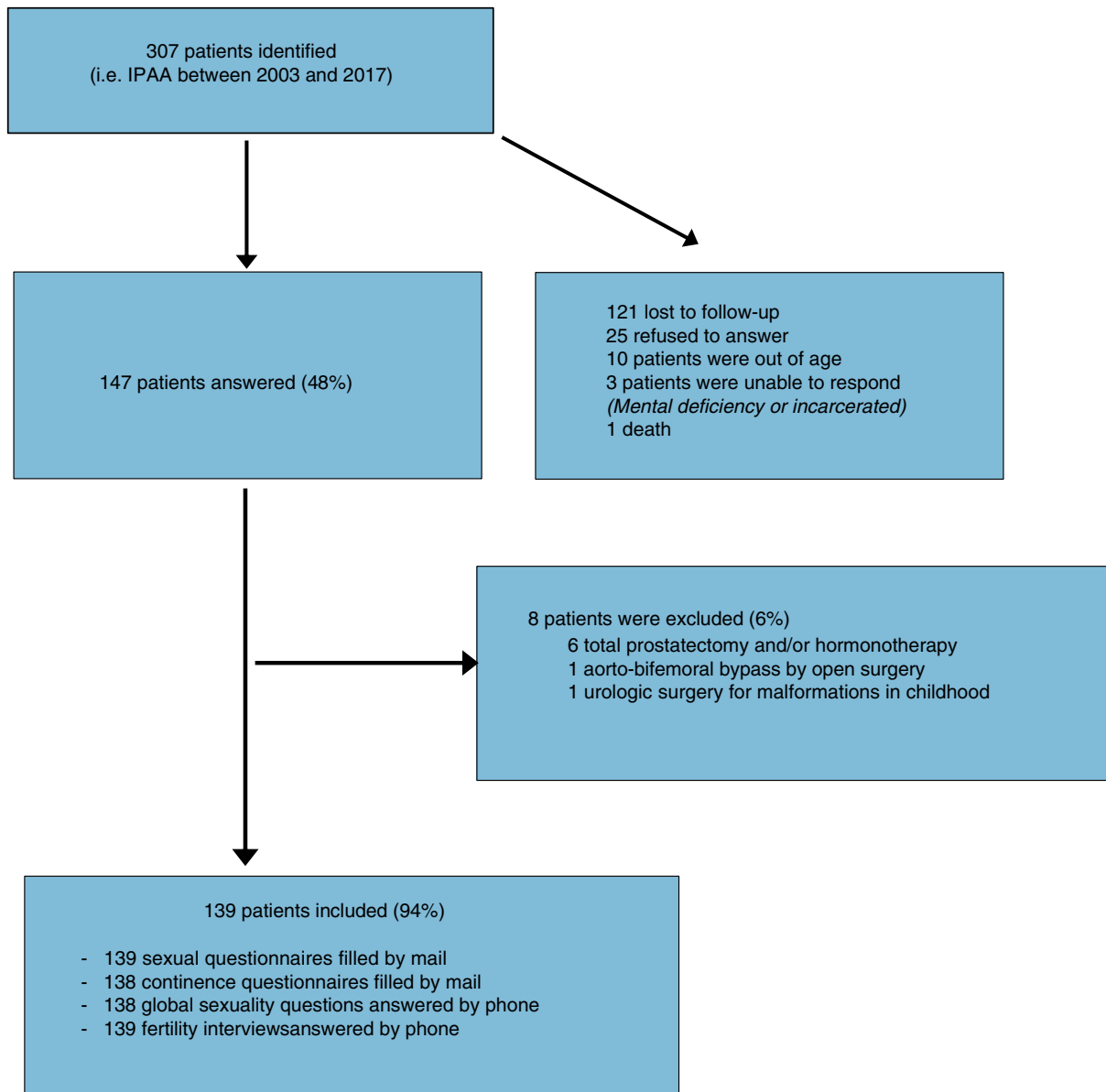
TP with IPAA was performed mostly by laparoscopy at NH, according to a previously described procedure [15], whereas it was initially performed by open surgery and then by laparoscopy after 2006 at SAH. Rectal dissection was performed by laparoscopy in almost all patients at NH, whereas it was performed either by laparoscopy or by a Pfannenstiel incision at SAH, according to the surgeon's practice. In both departments, rectal dissection was performed close to the rectal wall for an optimal preservation of the pelvic anatomy and nerves (in the case of cancer, TME was performed). An ileal pouch of 18 cm was created through a 5-cm incision in the right iliac fossa, at the site of the future ileostomy in the case of laparoscopic IPAA or across the Pfannenstiel incision. A stapled anastomosis was mostly performed in NH, whereas hand-sewn anastomosis was

mostly performed in SAH. In both centres, hand-sewn anastomosis was chosen in the case of cancer or dysplasia of the lower rectum, with perineal mucosectomy.

**Definitions**

Conversion to open surgery was defined as any unplanned incision or a planned incision longer than 6 cm. Mortality was defined as death occurring in the hospital or within 30 days. Postoperative morbidity was defined as complications occurring in the hospital or within 30 days after surgery. Major complications were defined as those requiring surgical, radiological or endoscopic intervention, life-threatening complications requiring intensive care management and death. Sepsis was defined as fever > 38.5°C or

leukocytosis > 15 000/mm<sup>3</sup>. The diagnosis of anastomotic leakage was confirmed by computed tomography (CT) with iodine injection and/or CT enema. Sexual dysfunction was defined as an IIEF-15 score < 25, according to previous publications [11]. The results of the IIEF-15 score were classified according to five degrees of dysfunction: severe, moderate dysfunction, minimal to moderate, minimal and no dysfunction. Pregnancy was defined as any pregnancy (childbirth, on-going pregnancy, miscarriage, extra-uterine pregnancy or abortion) confirmed by ultrasound scan of the partner. The desire for paternity was defined as the desire to have at least one child in the future, at the time of surgery. The paternity attempt was defined as regular unprotected intercourse. The time to pregnancy was defined as the time (in months) of unprotected intercourse before pregnancy. The Jorge–Wexner score was classified into four incontinence categories: minimal (0–4), moderate



**FIGURE 1** Flow chart

(5–9), significant (10–16) and severe (17 and over), as previously defined [12].

## Statistical analysis

The quantitative data were reported as the mean  $\pm$  standard deviation and range. Normally distributed quantitative data were analysed with Student's *t* test, and the Mann–Whitney test was used otherwise. The qualitative data were reported as the number of patients (percentage of patients) and were compared using the Pearson  $\chi^2$  test or Fisher's exact test, as appropriate. Multivariate analysis was performed using multiple logistic regression. The chosen variables were those significantly associated with or marginally significant for ED, in the univariate analysis ( $P < 0.05$ ), and those with clinical relevance. Odds ratios were expressed with 95% confidence intervals. The cumulative percentages of pregnancy after IPAA were plotted using the Kaplan–Meier method and compared with those of controls using the log-rank test.

The tests were always two-sided, and the level of statistical significance was set at  $P < 0.05$ . The analysis was performed using the Statistical Package for the Social Sciences software (SPSS, version 20.0, Chicago, Illinois, USA).

## RESULTS

Three hundred and seven patients were included. Among them, 147 (48%) answered. Eight patients were excluded: six had prostate cancer treated by total prostatectomy or hormone therapy, one had aorto-bifemoral bypass surgery and one underwent surgery for urological malformations during early childhood. Finally, 139 patients were included in the study (Figure 1). One patient did not respond to the Jorge–Wexner score and another to the short questions on global sexual function. Demographic data are reported in Table 1. Ninety-six (69%) patients had an IBD (90 UC, three Crohn's disease and three indeterminate colitis), 39 (28%) patients presented with FAP and four (3%) had hereditary non-polyposis colorectal cancer syndrome.

Perioperative data are reported in Table 2. Fifty-seven (41%) patients underwent open surgery, either due to previous abdominal surgery or according to the practice in the early 2000s. A conversion to open surgery was performed in 12 patients (15%), due to dissection issues in eight patients, haemorrhagic dissection in three patients and issues in mobilizing the pouch to the pelvic floor in one. TME was performed in 40 (29%) patients with the following indications: rectal cancer in 16 patients, rectal dysplasia in 13, multiple adenomas in 10 and a villous tumour with suspicion of adenocarcinoma in one. Thirteen patients presented with major complications (9%), including nine reoperations (four by open surgery), five radiological drainages and one postoperative compartment syndrome requiring fasciotomy. Nine patients have had extra-pelvic sepsis (i.e., without anastomotic leakage):

six urinary sepsis and three intra-abdominal collections, with no sepsis in the pelvic area.

## Sexual outcomes

The results of the IIEF-15 are presented in Table 3: one patient did not answer the sexual function questionnaire. The overall average score was 58/75 (whereas the mean score in a healthy population is 60.8 at 58 years [11]). Forty-six patients (33%) presented with ED, with 10% having severe dysfunction. In the univariate analysis (Table 4), six factors were identified to increase the risk of ED: age  $> 50$  at the time of the study, age  $> 50$  at the time of surgery, open surgery, rectal dissection by open surgery, TME and hand-sewn anastomosis. In the multivariate analysis (Table 4), age  $> 50$  years at the time of the study (OR 0.27, 95% CI 0.12–0.62,

**TABLE 1** Demographic data for 139 men who underwent ileal pouch–anal anastomosis

Variable	N (%)
Age at the time of surgery, years (range)	40 $\pm$ 14 (16–70)
Current age, years (range)	46 $\pm$ 14 (19–73)
Follow-up time, years (range)	6.3 $\pm$ 3.6 (1–13)
Body mass index, kg/m <sup>2</sup> (range)	24 $\pm$ 4 (14–35)
Smoking, <i>n</i> (%)	49 (35%)
Socio-educational level, <i>n</i> (%)	
High school diploma	27 (19%)
Second-year university level	27 (19%)
Fourth-year university level	14 (10%)
$\geq$ fifth-year university level	26 (19%)
Without high school diploma	42 (30%)
ASA score (range)	2 (1–3)
Medical history, <i>n</i> (%)	
Surgery	28 (20%)
Cardiovascular	16 (11%)
Pulmonary	4 (3%)
Neurological	2 (1%)
Diabetes	4 (3%)
Autoimmune disease	9 (6%)
Indication, <i>n</i> (%)	
Refractory colitis	55 (40%)
Dysplasia/cancer with FAP/IBD/HNPCC	35 (25%)
FAP	24 (17%)
Acute severe colitis	22 (16%)
Rectal stenosis	3 (2%)

Notes: Surgical history, except subtotal colectomy; autoimmune disease, except IBD. The data are reported as the mean  $\pm$  standard deviation and range.

Abbreviations: ASA, American Society of Anesthesiology; FAP, familial adenomatous polyposis; HNPCC, hereditary non-polyposis colorectal cancer syndrome; IBD, inflammatory bowel disease.

**TABLE 2** Perioperative data for 139 men who underwent ileal pouch–anal anastomosis

Surgical characteristics	N (%)
Surgical approach	
Laparoscopic	82 (59%)
All laparoscopic	49 (35%)
Laparoscopy-assisted	30 (22%)
Unknown <sup>a</sup>	3 (2%)
Open surgery	57 (41%)
Surgical procedures	
One stage	36 (26%)
Two stages	62 (44%)
IPAA/ileostomy	48 (34%)
STC/IPAA	14 (10%)
Three stages	40 (29%)
Completion proctectomy after STC and ISA	1 (1%)
Conversion to open surgery	12 (15%)
Laparoscopic rectal dissection <sup>a</sup>	49 (35%)
TME	40 (29%)
Ileostomy	85 (62%)
Anastomosis <sup>b</sup>	
Hand-sewn	95 (69%)
Stapled	43 (31%)
Perioperative blood transfusion	7 (6%)
Operating time, min	345 ± 85 (150–600)
Postoperative morbidity <sup>c</sup>	34 (24%)
Major	13 (9%)
Anastomotic leakage	7 (5%)
Ileus	8 (6%)
Extra-pelvic sepsis	9 (6%)
Length of stay, days	12 ± 6 (4–42)

Note:: The data are reported as the mean ± standard deviation and range.

Abbreviations: IPAA, ileal pouch–anal anastomosis; ISA, ileosigmoid anastomosis; STC, subtotal colectomy; TME, total mesorectal excision.

<sup>a</sup>Three patients with missing data on the type of rectal dissection (open vs. laparoscopic).

<sup>b</sup>One patient with missing data.

<sup>c</sup>Some patients have had multiple complications.

$P = 0.002$ ) and rectal dissection by open surgery (4.16, 95% CI 1.62–10.65,  $P = 0.003$ ) were the two independent risk factors for ED.

Global sexual function was assessed in 138 patients as unchanged in 97 (70%), better in one (1%) and worse in 40 (29%) patients. Ejaculation was unchanged in 102 (73%) patients and inconstant or decreased in 36 (27%). No independent risk factors were identified to either decreased global sexual function or decreased ejaculation.

**TABLE 3** Results of the international index of erectile function (IIEF-15) in 139 men after undergoing ileal pouch–anal anastomosis

Item	N (%)
Erectile function, n (%)	
No dysfunction	93 (67%)
Dysfunction	46 (33%)
Mild	19 (14%)
Mild-moderate	7 (5%)
Moderate	6 (4%)
Severe	14 (10%)
Sexual desire, n (%)	
No dysfunction	75 (54%)
Dysfunction	64 (46%)
Mild	40 (29%)
Mild-moderate	10 (7%)
Moderate	7 (5%)
Severe	7 (5%)
Orgasm function, n (%)	
No dysfunction	101 (73%)
Dysfunction	38 (27%)
Mild	13 (9%)
Mild-moderate	8 (6%)
Moderate	6 (4%)
Severe	11 (8%)
Intercourse satisfaction, n (%)	
No dysfunction	64 (46%)
Dysfunction	75 (56%)
Mild	43 (31%)
Mild-moderate	9 (6%)
Moderate	12 (9%)
Severe	1 (8%)
Overall satisfaction, n (%)	
No dysfunction	46 (33%)
Dysfunction	93 (77%)
Mild	47 (34%)
Mild-moderate	26 (19%)
Moderate	12 (9%)
Severe	8 (6%)

### Fertility assessment

Results for postoperative fertility and comparison to controls are summarized in Table 5. The groups were matched as requested on the three following criteria: follow-up ( $P = 0.35$ ), age at the time of surgery ( $P = 0.27$ ) and desire for paternity ( $P = 0.8$ ). Comparison of the two populations found no difference in fertility over time ( $P = 0.46$ , Figure 2).

Four IPAA patients (17%) who obtained pregnancy had an ED (two severe and two mild dysfunction). Two IPAA patients who tried to have



**TABLE 5** Comparison of fertility between 139 men attempting pregnancy in their couple after undergoing ileal pouch–anal anastomosis compared with 121 controls who underwent appendectomy

	IPAA n = 139	Appendectomy n = 121	P
Age at surgery	40 ± 14 (16–70)	39 ± 12 (16–65)	0.27
Follow-up	6.3 ± 3.6 (1–13)	6.7 ± 3.2 (0.7–13)	0.35
Paternity desire	36 (26%)	34 (28%)	0.80
Attempted paternity	19 (13%)	31 (26%)	0.02
Pregnancy	23 (16%)	27 (22%)	0.29
Pregnancy at 1 year <sup>a</sup>	18 (78%)	22 (81%)	1

Note:: The data are reported as the mean ± standard deviation and range.

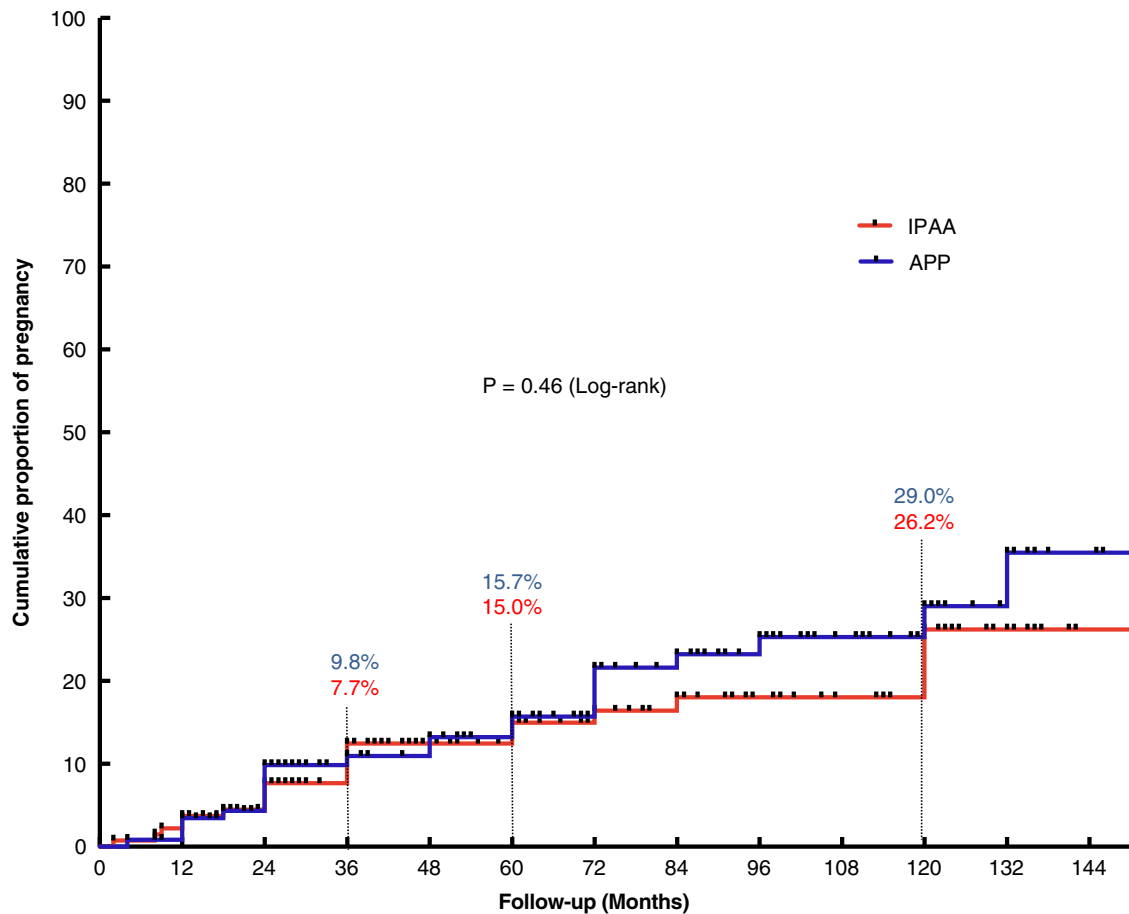
Abbreviation: IPAA, ileal pouch–anal anastomosis.

<sup>a</sup>Number of pregnancies at 1 year among all pregnancies.

## DISCUSSION AND CONCLUSIONS

This study assessed ED and male fertility after IPAA in 139 patients. Demographic data were comparable to those in the literature [10,16,17]. ED was found in 33% of patients, including 10% with severe ED. Two independent risk factors for ED were identified: age > 50 years and rectal dissection by open surgery. Male fertility was not impaired by IPAA. Finally, risk factors for incontinence were age > 50 years at the time of IPAA and hand-sewn anastomosis.

In our series, 46 patients (33%) presented with ED. This is higher than in previous studies. However, more than half of these patients presented with mild or mild to moderate ED. In the whole population, 10% had severe ED: these most impaired patients are probably those who complain about ED to their surgeons. Furthermore, there is a ‘taboo’ on erectile function in men: there may have been an underestimation of ED in previous studies, and it may still be underestimated in our own work. Finally, the 48% response rate could bias these results, but in both ways: either an overestimation or an



IPAA	135	119	77	59	42	30
APP	118	104	78	57	37	20

**FIGURE 2** Time to pregnancy in 135 men attempting pregnancy in their couple after ileal pouch–anal anastomosis compared with 121 controls after appendectomy (Kaplan–Meier)

underestimation of postoperative ED. It should therefore be noticed that global ED, encompassing mild, moderate and severe dysfunction, is probably underestimated by colorectal surgeons in IPAA and should be systematically explained to the patients during preoperative clinical review, even in benign cases.

Farouk et al. [18] assessed the long-term results of IPAA for IBD in men and women. Before surgery, 16% of patients had no sexual relationship and 20% had 'reduced' sexual activity. An improvement in the overall satisfaction of sexual function in the postoperative setting was found in 25% of patients. Gorgun et al. [17] assessed sexual function before and after IPAA in 122 patients (25% of responders). The postoperative results of IIEF-15 were significantly improved. This can be explained by a bias due to the low rate of responders and by the fact that questionnaires were given during the acute phase of the disease. Harnoy et al. [19] found ED in 29% of patients and the only risk factor identified was nocturnal anal incontinence. Other studies [7,20] found sexual dysfunction in about 20% of cases. However, these studies did not specifically assess men, who were 31%–46% of the whole population.

The fairly low response rate to the questionnaires (48%) (due to patients lost to follow-up or not wishing to participate) may be explained by the long time from surgery in some patients, and by their intimate aspect. Furthermore, as the study was retrospective, no attempt was made to assess preoperative sexual function, libido or attempt to bear children because of the high risk of inaccuracy in the patients' answers.

Open rectal dissection was identified as one of the two independent risk factors for ED, along with an age > 50 years. Preservation of erectile function may therefore be another benefit of laparoscopy over open surgery, in addition to those already demonstrated in two meta-analyses [21,22]. Our study found a relatively small proportion of laparoscopic approach. Indeed, only 82 patients (59%) had a laparoscopic IPAA, which is in accordance with recent publications [23].

TME was a risk factor for ED in the univariate analysis. Indeed, TME carries the risk of damaging genitourinary nerves [5,6]. If TME is paramount in the case of rectal cancer, it is not justified for benign disease. Lindsey et al. [24] compared the influence of TME versus partial excision on the erectile function in 156 patients. They found 3.8% of patients with complete impotence, 13.5% with partial impotence; no significant differences were found between the two groups. However, in their randomized controlled trial, Bartels et al. [25] compared TME with dissection close to the rectal wall in IPAA: severe complications were less frequent and quality of life better in the dissection close to the rectal wall group. Our study found higher rates of ED after TME than Lindsey et al. [24] (17 patients, 49%), confirming that TME should be avoided in the absence of cancer.

The impact of IPAA in women's fertility has already been well studied. A decline in fertility had been described initially [26,27], in studies including open IPAA. Three studies assessed fertility after laparoscopic IPAA with reassuring results [9,10,16]: in the Bartels et al. [9] study, fertility over time was better after laparoscopic IPAA compared with open IPAA; Beyer-Berjot et al. [10] compared fertility in women after laparoscopic IPAA and appendectomy; there were

no differences between groups. Harnoy et al. [19] found no differences between hand-sewn and stapled IPAA on fertility and sexual function. However, no studies have assessed the impact of IPAA on male fertility specifically.

Most data focus on fertility in IBD and not surgery, finding normal fertility in quiescent IBD [28,29] and a lower paternal desire (explained by the risk of transmission of the disease, the potentially teratogenic effects of the treatments [30] and the presence of a depressive syndrome [31,32]). Likewise, the rate of paternal desire was low in our series, yet similar in both groups and concordant with the literature [10,16]. The choice of patients having undergone appendectomy as controls was based on getting data from the general population, accessible from a surgical database. The purpose was not to compare patients after IPAA and non-operated IBD or FAP patients but to compare IPAA patients (encompassing both the procedure and the population in which such procedure was performed) with demographically based controls in the general population. There were no impairments in male fertility after IPAA, despite a weaker or inconstant ejaculation in 37 (27%) patients. However, these results are clinical and only a spermogram would confirm the absence of impact on male fertility.

Our study was not designed to assess risk factors for anal incontinence. However, it seemed that hand-sewn anastomosis and an age over 50 years at the time of IPAA were risk factors for incontinence. Likewise, a large meta-analysis reported better anal function after stapled IPAA but with clinical impact only on night seepage [33]. Moreover, if cancer on the remaining mucosa is feared in the case of stapled anastomosis, such cases have also been described after hand-sewn anastomoses [34].

A total laparoscopic approach, including rectal dissection, should be preferred in IPAA to preserve erectile function. In this young population, IPAA did not impact fertility.

## DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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