ORIGINAL ARTICLE

Risk adjusted benchmarking of abdominoperineal excision for rectal adenocarcinoma in the context of the Belgian PROCARE improvement project

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ABSTRACT

Objective The abdominoperineal excision (APE) rate, a quality of care indicator in rectal cancer surgery, has been criticised if not adjusted for confounding factors. This study evaluates variability in APE rate between centres participating in PROCARE, a Belgian improvement initiative, before and after risk adjustment. It also explores the effect of merging the Hartmann resections (HR) rate with that of APE on benchmarking.

Design Data of 3197 patients who underwent elective radical resection for invasive rectal adenocarcinoma up to 15 cm were registered between January 2006 and March 2011 by 59 centres, each with at least 10 patients in the registry. Variability of APE or merged APE/HR rates between centres was analysed before and after adjustment for gender, age, ASA score (3 or more), tumour level (rectal third), depth of tumour invasion (cT4) and preoperative incontinence.

Results The overall APE rate was 21.1% (95% CI 19.7 to 22.5%). Significant variation of the APE rate was observed before and after risk adjustment ($p<0.0001$). For cancers in the lower rectal third, the overall APE rate increased to 45.8% (95% CI 43.1 to 48.5%). Also, variation between centres increased. Risk adjustment influenced the identification of outliers. HR was performed in only 2.6% of patients. However, merging of risk adjusted APE and HR rates identified other centres with outlying definitive colostomy rates than APE rate alone.

Conclusion Significant variation of the APE rate was observed. Adjustment for confounding factors as well as merging HR with APE rates were found to be important for the assessment of performances.

Significance of this study

What is already known on this subject?
- Abdominoperineal excision (APE) rate is a quality of care indicator in rectal cancer surgery.
- Benchmarking of centres for APE rate has been criticised if not adjusted for confounding clinical factors.
- Hartmann resections have not been included in APE rate calculations.

What are the new findings?
- For appropriate benchmarking, the APE rate of centres needs to be adjusted for confounding clinical factors. In this study, gender, age, ASA score (3 or more), tumour level (rectal third), depth of tumour invasion (cT4) and preoperative incontinence were used for adjustment.
- Merging of Hartmann resection and APE rates has an impact on risk adjusted benchmarking.

How might it impact on clinical practice in the foreseeable future?
- Audit of APE rate cannot be based on administrative data only.
- Relevant clinical confounders have to be defined and used for benchmarking.
- Hartmann resection and APE rates have to be merged for benchmarking.

INTRODUCTION

The rate of abdominoperineal excision (APE) of the rectum is considered as one of the quality of care indicators in rectal cancer surgery.[1–4] Management of rectal cancer has evolved significantly over the past few decades with a decline in the APE rate.[5 6] Specific projects have fostered this evolution—for example, in Sweden, Norway, The Netherlands and Canada.[7–10] PROCARE, a Belgian multidisciplinary profession driven project on rectal cancer, was launched in 2006 because variability in the management of patients with rectal cancer between hospitals, including the APE rate, was high.[11] All centres were invited to participate on a voluntary basis. Variation in APE rate between hospitals or surgical teams has been documented in the UK.[5 6] These data have been criticised because a number of relevant confounding factors had not been or could not be taken into account. Indeed, data were derived from administrative databases that do not allow adjustment for clinical factors. Several studies using multivariable analysis identified factors independently associated with APE: male gender, age >60 years, social deprivation, coloured race, low tumour location, deep tumour invasion, use of neoadjuvant radiotherapy, surgeon with low case load, surgeon without specialist colorectal training, low procedural hospital volume, rural hospital location and non-teaching hospital status.[2 6 12–15] It should be noted that a decrease in

APE with age has been reported and that hospital or surgeon volume and teaching status were not found to be associated with the APE rate in other large studies using multivariable analysis.[1 5 16] In any case, it is evident that benchmarking for APE requires adjustment for confounding 'risk' factors judged to be clinically relevant. The PROCARE data entry set was designed to allow benchmarking for such factors. In published surveys, Hartmann resections (HR) are either not mentioned or not merged with APE for calculation of the APE rate. However, patients who undergo an HR for rectal cancer most probably have a definitive colostomy.

The aim of this study was to assess the effect of risk adjustment for a predetermined set of factors on the variability of APE rates between participating centres. Analyses were repeated after merging APE and HR.

PATIENTS AND METHODS

Between 1 January 2006 and 31 March 2011, 3290 patients underwent elective radical rectal resection—that is, either an APE, HR or any type of sphincter sparing operation (SSO) with coloanal anastomosis, for invasive adenocarcinoma of the rectum located between 0 and 15 cm above the anal verge. They were registered on a voluntary basis by 82 out of 111 possible centres in a dedicated database at the Belgian Cancer Registry (BCR). A number of patients were excluded from the study: patients operated on in an emergency (n=53) or in whom the circumstances of surgery were unknown (n=126), patients who underwent total proctocolectomy with definitive ileostomy (n=2) or ileal pouch–anal anastomosis (n=9), patients undergoing local excision, including transanal endoscopic resection (n=47), and patients for whom the type of radical resection was unknown (n=28). Of the 3290 patients with radical resection, 93 patients from 23 centres with fewer than 10 patients in the registry (APE in 25 patients, HR in three patients and SSO in 65 patients) were excluded, leaving data from 3197 patients from 59 centres with 10 or more patients for further analysis.

In view of participation on a voluntary basis, completeness of registration was assessed through linkage of the BCR, the Intermutualistic Agency (IMA) database and the PROCARE database. A population based sample of all rectal cancers (International Classification of Diseases for Oncology, 3rd edition ICD-O-3 C20) diagnosed in Belgium between 1 January 2006 and 30 June 2008 was available in the BCR. It is mandatory for all pathology laboratories and hospitals to report cases to the BCR. Patients who underwent radical resection (codes 244042 and 243062 for anterior resection, code 244020 for APE, code 244064 for HR procedure) between 2006 and 2008 were identified in the IMA database. The IMA is an association of the seven Belgian health insurance companies integrating all data related to the medical treatment of all Belgian patients. Health insurance is obligatory for Belgian citizens. Linkage of these data with those of the BCR registry was authorized by the IMA monitoring committee. Merging of data indicated that 44% (1830/

Table 1 Demographic data and tumour characteristics in all patients and in those who underwent abdominoperineal excision of the rectum, Hartmann resection or sphincter saving operations

	Global*	APE*	Hartmann*	SSO*	p Value
No of patients	3197	673	84	2440	
Male	1963 (61)	407 (60)	53 (63)	1503 (62)	0.60
Female	1234 (39)	266 (40)	31 (37)	937 (38)	
Age (years) (mean (IQR))	67 (59–76)	68.5 (60–77)	75.7 (70.5–85)	66.3 (59–75)	<0.001
Body mass index (mean (IQR))	25.8 (23–28)	25.8 (23–28)	24 (21–26)	25.9 (23–28)	0.56
ASA 1	798/2914 (28)	144/598 (24)	6/80 (8)	648/2236 (29)	<0.001
ASA 2	1496/2914 (51)	297/598 (50)	32/80 (40)	1167/2236 (52)	
ASA 3 or more	620/2914 (21)	157/598 (26)	42/80 (52)	421/2236 (19)	
Preoperative faecal incontinence	378/3109 (12)	116/662 (18)	29/83 (35)	233/2364 (10)	<0.001
Upper rectal third (>10–15 cm)	547/3119 (18)	6/655 (1)	14/84 (17)	527/2380 (22)	<0.001
Mid rectal third (>5–10 cm)	1249/3119 (40)	43/655 (7)	44/84 (52)	1162/2380 (49)	
Lower rectal third (0–5 cm)	1323/3119 (42)	606/655 (92)	26/84 (31)	691/2380 (29)	
Distance from anal verge (cm) (mean (IQR))	6.7 (3–10)	2.1 (0–3)	7.7 (5–10)	8 (5–10)	<0.001
cT4	302/3048 (10)	139/655 (21)	19/80 (24)	144/2313 (6)	<0.001
cStage 0–I	407/2917 (14)	60/626 (10)	4/76 (5)	343/2215 (15)	<0.001
cStage II	504/2917 (17)	132/626 (21)	17/76 (22)	355/2215 (16)	
cStage III	1634/2917 (56)	352/626 (56)	37/76 (49)	1245/2215 (56)	
cStage IV	372/2917 (13)	82/626 (13)	18/76 (24)	272/2215 (12)	
Neoadjuvant radio (chemo)therapy	2106/3197 (66)	510/673 (76)	31/84 (37)	1565/2440 (64)	<0.001
ypStage 0	278/2983 (9)	49/624 (8)	2/80 (3)	227/2279 (10)	0.53
(y)pStage I	763/2983 (26)	167/624 (27)	8/80 (10)	588/2279 (26)	
(y)pStage II	743/2983 (25)	156/624 (25)	26/80 (32)	561/2279 (25)	
(y)pStage III	791/2983 (26)	162/624 (26)	25/80 (31)	604/2279 (26)	
(y)pStage IV	408/2983 (14)	90/624 (14)	29/80 (24)	299/2279 (13)	
(y)pCRM invaded (0 mm)	193/2148 (9)	67/450 (15)	14/57 (25)	112/1641 (7)	<0.001
Open resection	2192/3186 (69)	478/670 (71)	74/82 (90)	1640/2434 (67)	0.05
Laparoscopic or converted resection	994/3186 (31)	192/670 (29)	8/82 (10)	794/2434 (33)	
Low volume centres (<10/year)	647/3197 (20)	160/673 (24)	23/84 (27)	464/2440 (19)	0.006
High volume centres (10 or more/in at least 1 year)	2550/3197 (80)	513/673 (76)	61/84 (73)	1976/2440 (81)	

Percentages or IQR in parentheses. p Value (Mann–Whitney U test or χ^2 test as appropriate) for the comparison of APE with SSO.
*Note that for percentages the denominators are mentioned since for some characteristics information for some subjects was missing.
APE, abdominoperineal excision; SSO, sphincter saving operation.

4135) of patients who underwent radical resection between 2006 and mid 2008 were registered in PROCARE during the initial 2.5 years of the project.

Based on literature data related to confounding factors for the APE rate in rectal cancer surgery and on expert opinion, eight experts (four surgeons, three pathologists and one oncologist) from the PROCARE Steering Group decided on consensus to retain the following factors for adjusted benchmarking: male gender, age >60 years, tumour level (per rectal third), depth of tumour invasion (cT4), ASA 3 or more and the presence of preoperative incontinence. The expert panel also proposed to compare the observed APE rate per centre with 95% prediction limits around the overall APE rate for rectal cancer at any level as well as for cancers located in the lower rectal third.

The following definitions were used for the location of rectal cancer according to its lower limit: lower third from 0 to 5 cm, mid-rectal third from >5 to 10 cm and upper third from >10 to 15 cm above the anal verge. Tumour location had been determined preferentially at rigid proctoscopy or otherwise at withdrawal of a colonoscope. Centres were categorised as high volume if 10 or more patients had been entered into the registry in at least 1 year of participation.

Analysis

All analyses were performed on anonymous data of patients from centres with at least 10 patients in the registry. A logistic regression model with a random centre effect was used to formally test the differences between centres in APE/HR rates, with and without correction for risk factors.[17 18] Normal distribution was assumed for the random effects. The SD of this distribution reflects heterogeneity—that is, the variability between the centres exceeding the sampling variability. The χ^2 statistic from the likelihood ratio test comparing the models with and without random centre effect is given. The observed APE rate was plotted versus the volume per centre in funnel plots with 95% and 99% prediction limits around the overall APE/HR rate to illustrate whether the observed variability exceeded the differences between centres due to pure sampling variability. These limits indicate the range wherein, for example, 95% of the observed rates are expected if all centres had the same APE probability. The larger the centres, the smaller the range. Prediction limits were constructed based on binomial distribution with a continuity correction.[19] An outlier is defined as a centre having a higher rate than the upper limit of the 95% prediction interval in this plot (ie, higher than the 97.5th percentile of the predicted distribution). Risk adjusted analyses were performed with and without exclusion of patients with missing data for one or more of the above mentioned risk factors. Risk adjusted APE rates were obtained by multiplying the overall APE rate in the dataset with the ratio O/E, where O refers to the observed number of APE and E to the expected number of APE after adjustment for the risk factors. Information on all risk factors was available for 2767 patients (87%). There was significant variability between the centres in the rate of missing predictor information. However, there was no evidence for a relation between missing data and APE rate, whether or not merged with HR rate, either at the patient level (ie, a patient with missing predictor information did not have a significantly different APE or APE+HR probability) or at the centre level (ie, centres with a high level of missing predictor information did not have a different APE or APE+HR rate). Results based on patients without missing information on risk factors are presented. The χ^2 or Fisher exact tests were used to compare APE rates between groups of patients.

RESULTS

The median number of patients per centre was 37 (range 12–291). There were 25 low volume centres. Of the 34 high volume centres, 25 registered data on 10–19 radical resections per year, seven submitted 20–29 and two more than 30 patients per year. Demographic patient data, tumour characteristics and some surgery related aspects are summarised in table 1.

There were 61% male patients. Mean age was 67 years (IQR 59–76). A laparoscopic or laparoscopy converted resection was performed in approximately 30% of APE and SSO but only in 10% of HR (p<0.001). Eighty per cent of patients were operated on in high volume centres.

The overall APE rate in the dataset was 21.1% (95% CI 19.7 to 22.5%). In univariate analysis a significant effect of the predefined risk factors was found for age as a linear term (p=0.0002), ASA class 3 or more (p<0.001), tumour level categorised per rectal third (p<0.0001), depth of invasion (cT4; p<0.001) and preoperative faecal incontinence (p<0.001), but not for gender (p=0.579). The evidence for a centre effect on APE rate for rectal cancer at any level from 0 to 15 cm above the anal verge was significant, both before (p<0.0001) and after adjustment (p<0.0001) for age, gender, ASA 3 or more, level of the tumour (per third), cT4 and incontinence. Variability between centres was funnel plotted around the overall APE rate for rectal cancer at any level with 95% and 99% prediction limits before and after risk adjustment (figure 1A,B). Eight centres were identified as outliers before adjustment. After adjustment, only three of these

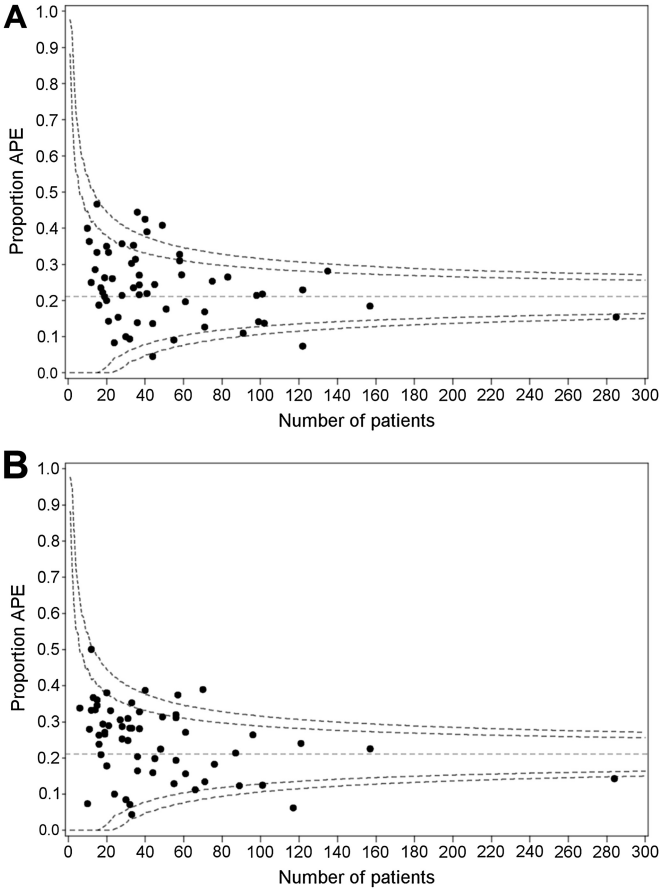

Figure 1 Variability between centres around the overall abdominoperineal excision (APE) rate for cancer at any level, with 95% and 99% prediction limits before (A) and after (B) risk adjustment. Results are based on patients with no missing data for risk factors.

Table 2 Demographic data and tumour characteristics in patients in lower rectal third, distinguishing between those who underwent abdominoperineal excision of the rectum, Hartmann resection or sphincter saving operations

	Global*	APE*	Hartmann*	SSO*	p Value
No of patients	1323	606	26	691	
Male	806 (61)	358 (59)	13 (50)	435 (63)	0.15
Female	517 (39)	248 (41)	13 (50)	256 (37)	
Age (years) (mean (IQR))	66.5 (59–76)	68.3 (60–78)	76.4 (76–85)	64.5 (57–73)	<0.001
Body mass index (mean (IQR))	25.8 (22.7–28.4)	25.8 (22.6–28.3)	22.4 (18.1–25.3)	25.9 (22.7–28.4)	0.64
ASA 1	317/1213 (26)	131/542 (24)	0/26 (0)	186/645 (29)	0.004
ASA 2	633/1213 (52)	274/542 (51)	14/26 (54)	345/645 (53)	
ASA 3 or more	263/1213 (22)	137/542 (25)	12/26 (46)	114/645 (18)	
Preoperative faecal incontinence	204/1292 (16)	107/597 (18)	11/26 (42)	86/669 (13)	0.015
Distance from anal verge (cm) (mean (IQR))	2.8 (1–4)	1.7 (0–3)	3.5 (2–5)	3.7 (3–5)	<0.001
cT4	178/1286 (14)	127/591 (21)	5/25 (20)	46/670 (7)	<0.001
cStage 0–I	146/1242 (12)	59/568 (10)	0/25 (0)	87/649 (13)	0.0006
cStage II	219/1242 (18)	123/568 (22)	8/25 (32)	88/649 (14)	
cStage III	733/1242 (59)	316/568 (56)	13/25 (52)	404/649 (62)	
cStage IV	144/1242 (11)	70/568 (12)	4/25 (16)	70/649 (11)	
Neoadjuvant radio (chemo)therapy	1037/1323 (78)	461/606 (76)	10/26 (39)	566/691 (82)	0.011
ypStage 0	127/1240 (10)	45/559 (8)	0/25 (0)	82/656 (13)	0.032
(y)pStage I	356/1240 (29)	153/559 (27)	1/25 (4)	202/656 (31)	
(y)pStage II	283/1240 (23)	138/559 (25)	10/25 (40)	135/656 (20)	
(y)pStage III	313/1240 (25)	145/559 (26)	9/25 (36)	159/656 (24)	
(y)pStage IV	161/1240 (13)	78/559 (14)	5/25 (20)	78/656 (12)	
(y)pCRM invaded (0 mm)	95/919 (10)	61/403 (15)	4/23 (17)	30/493 (6)	<0.001
Open resection	986/1318 (75)	427/603 (71)	23/25 (92)	536/690 (78)	0.003
Laparoscopic or converted resection	332/1318 (25)	176/603 (29)	2/25 (8)	154/690 (22)	
Low volume centres (<10/year)	249/1323 (19)	147/606 (24)	6/26 (23)	96/691 (14)	<0.001
High volume centres (10 or more/in at least 1 year)	1074/1323 (81)	459/606 (76)	20/26 (77)	595/691 (86)	

Percentages or IQR in parentheses. p Value (Mann–Whitney U test or χ^2 test as appropriate) for the comparison of APE with SSO.
*Note that for percentages the denominators are mentioned since for some characteristics information for some subjects was missing.
APE, abdominoperineal excision; SSO, sphincter saving operation.

eight centres were retained as outliers while another three centres were identified with unusually high APE rates. Risk adjustment had an effect on the 'percentile performance' of most centres, in either sense (figure 3A).

When the analysis was limited to the 1323 patients with rectal cancer in the lower third, the observed percentage of APE increased to 45.8% (95% CI 43.1% to 48.5%), as could be expected. Demographic patient data, tumour characteristics and some surgery related aspects are summarised in table 2.

Compared with the results for rectal cancer at any level between 0 and 15 cm above the anal verge, the variability of APE rate between centres for low rectal cancer was more pronounced Indeed, the likelihood ratio test χ^2 was 31.9 and the SD of the random effects distribution was 0.40 (SE=0.07) for all patients compared with χ^2=82.4 and SD=0.71 (SE=0.11) for the patients with rectal cancer in the lower third. This was the case both before and after risk adjustment (figure 2A,B). Before adjustment, 14 centres were located above the upper 95% prediction limit. After adjusted benchmarking, eight of these 14 centres and another two centres were identified as outliers (figure 3B). Only six centres were identified as outliers in the analysis for all rectal cancers as well as in the analysis for lower third rectal cancer.

HR was performed in only 2.6% of patients (95% CI 2.1% to 3.2%). Compared with patients who underwent SSO, patients who underwent HR were more frequently elderly (>75 years) and frail (ASA 3 or more), with preoperative incontinence and deeply infiltrating tumours (cT4) or metastatic disease (tables 1 and 3).

A similar but sometimes less pronounced trend was observed for APE compared with SSO, except for metastatic disease. In contrast with patients undergoing APE, those who underwent HR received significantly less neoadjuvant radiotherapy, possibly related to their older age and frailty. Merging HR with APE rates had a limited effect on the overall 'definitive colostomy' rate (23.7% (95% CI 22.2% to 25.2%)). Factors significantly associated with the merged APE and HR rate were identical to those identified for the APE rate (data not shown). Compared with APE, merging of APE and HR rates for rectal cancer at any level classified one outlying centre out of six below the 95% upper prediction limit while one centre's performance moved to a level above that limit (figure 3C). Noteworthy is that the centre which had been identified as an outlier only after merging APE and HR rates is among the larger centres and reported on 30 APE and eight HR procedures. Compared with APE, merging of APE and HR rates for rectal cancer in the lower third classified two outlying centres out of 10 below the 95% upper prediction limit while two additional centres were identified as outliers (figure 3D).

DISCUSSION

The overall APE rate in PROCARE was 21.1%, a result comparable with the 23–24% reported in recent population based samples from the UK and from Victoria, Australia.[6 14 20] For low rectal cancer (0–5 cm), the APE increased to 45.8%, approaching the 42.8% rate reported in Victoria, Australia in patients operated on by members of the Colorectal Surgical Society of Australia and New Zealand.[14] Because participation in the

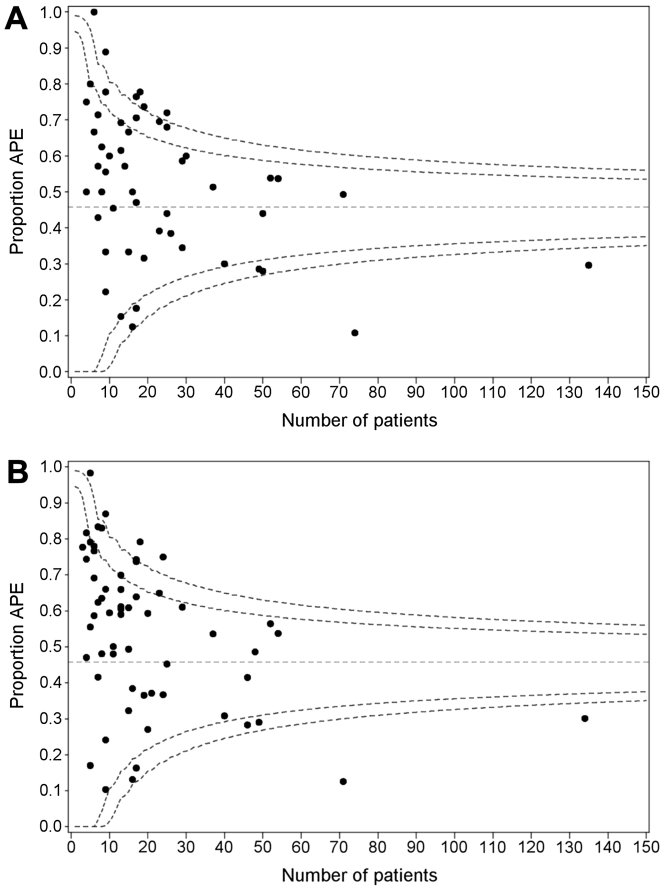

Figure 2 Variability between centres around the overall abdominoperineal excision (APE) rate for low rectal cancer, with 95% and 99% prediction limits before (A) and after (B) adjustment. Results are based on patients with no missing data for risk factors.

PROCARE project is on a voluntary basis, the APE rates do not necessarily reflect the overall performance of Belgian centres. Merging of the PROCARE database with administrative databases indicated that 56% of patients who underwent radical resection of the rectum between 2006 and mid 2008 were not registered in PROCARE. This is related to the fact that the project was launched in January 2006. Centres could join (and leave) the project at any time. More recent administrative data were not available. Remarkably, the 21.8% APE rate (502/2305; 95% CI 20.1% to 23.5%) in these non-registered patients was comparable (p=0.53) with those observed in the present study. The 26.5% merged APE + HR rate (611/2305; 95% CI 24.7% to 28.4%) was slightly but significantly higher (p=0.018). Registration bias by some centres cannot be excluded. Therefore, aspects of incomplete registration and possible bias will be assessed in a separate study. The present study only aimed to illustrate the effect of both risk adjustment and merging HR with APE rates when evaluating performance in different centres.

Over the past decades a significant decrease in the APE rate has been documented in several countries. Despite improved SSO, significant variation of APE rates persist between centres, as illustrated in the UK and USA.[6 15] However, benchmarking based on administrative data has been rightly contested because data were not adjusted for relevant clinical confounding factors. In an effort to circumvent the problem of missing information on the location of the tumour, the distance from the tumour to the dentate line mentioned in pathology reports was compared with APE rates. Variation in APE use were not explained by variation of the distance to the dentate line; specialist high volume surgeons undertook fewer APE and those they performed were in tumours closer to the dentate line than low volume non-specialist surgeons.[21] Tumour location is very important and should also be known in patients undergoing sphincter sparing procedures. However, this is only one of several factors taken into account during surgical decision making. To our knowledge, this is the first survey assessing the effect of preoperative, clinical risk adjustment for benchmarking of APE rates between centres. In the literature, several factors were reported to be independently related to APE for rectal cancer. Although these factors may explain or predict the performance of APE, at least some of them might not be acceptable for adjusted benchmarking from a patient's and professional point of view. In consensus between experts, gender, age, tumour level (per rectal third), depth of tumour invasion (cT4), ASA 3 or more and the presence of preoperative incontinence were used for risk adjustment in this study. Thus social deprivation, coloured race, use of neoadjuvant radiotherapy, the surgeon's case load or specialisation, the procedural volume of a hospital, and its location or teaching (academic) status were not considered as valid and professionally acceptable reasons for a possibly higher APE rate. Ideally, they should not affect the APE rate. In countries with well functioning healthcare and social security systems, good quality health services should be accessible for all citizens. Moreover, the effect of some of these factors on the APE rate is controversial—for example, socioeconomic status, neoadjuvant radiotherapy, the surgeon's case load or hospital volume or teaching status.[1 16 22 23] In the present study, a significant variation in APE rate was observed both before and after risk adjustment. Risk adjusted benchmarking proved to be relevant for the identification of outliers.

Low HR is considered to have a lower operative risk than APE or SSO. Therefore, it is performed in patients with rectal cancer not invading the pelvic floor or anal sphincters and with contraindications for APE or SSO because of old age, high ASA score, faecal incontinence or metastatic disease requiring postoperative palliative chemotherapy as soon as possible. As expected, in this study, HR was mainly performed in elderly, frail and/or incontinent patients. The observed HR rate of 2.6% was smaller than the 6.7% rate reported in the National Bowel Cancer Project report of 2010.[20] The difference can be explained by the fact that emergency surgery was excluded from the present study. In spite of the limited HR rate, merging HR and APE rates had an effect on the benchmarking of some centres. Thus HR should be part of the quality of care indicator related to definitive stoma rate. One could or should also consider including those patients in whom a defunctioning loop stoma is not closed after a given time period of, for example, 1 or 2 years. Indeed, 19% of 'temporary' stomas were not reversed after a median follow-up of 7.1 years (range 2.5–9.8 years), particularly if the stoma had to be constructed during a second or subsequent procedure after total mesorectal excision.[24]

This study focused on risk adjusted benchmarking of centres and illustrates its relevance for the identification of outliers for APE performance. It should be taken into account that the APE or definitive stoma rate is only one of several quality of care indicators to be monitored in the management of patients with rectal cancer. Moreover, aiming at a reduction of variability in process and outcome measures through appropriate feedback might be preferable and more effective than head hunting outliers for one or more quality of care indicators. Although the

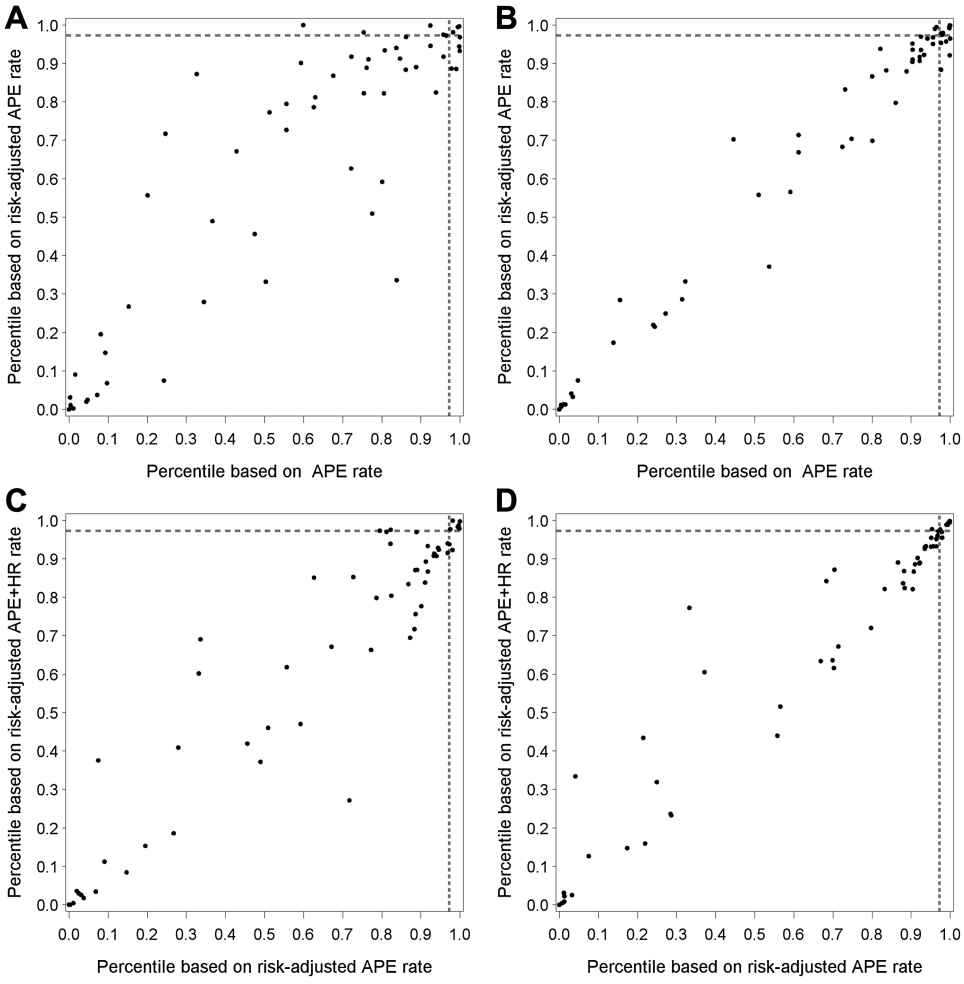

Figure 3 Scatterplots of the centre specific percentiles (percentiles in the predicted distribution assuming a common rate) obtained before and after risk adjustment, before and after merging Hartmann resection with abdominoperineal resections. (A) Impact of risk adjustment for rectal cancer at any level. (B) Impact of risk adjustment for rectal cancer in the lower third. (C) Impact of merging Hartmann resection with abdominoperineal excision (APE) for rectal cancer at any level. (D) Impact of merging Hartmann resection with APE for rectal cancer in the lower third. The broken lines indicate the upper limit of the 95% prediction interval (percentile 97.5).

adjusted APE or joint APE/HR rates were higher in low volume centres, several of these centres performed as well as high volume centres. Thus limiting surgery to surgeons with inherent and documented oncological surgical proficiency may be more important than simple centralisation.[25] Every centre and surgeon should try to improve and achieve a high standard of efficiency. Those known to perform less well compared with other centres should react immediately. Because of the large number of patients with rectal cancer, limiting their treatment to centres of excellence is not an option.[26] Preferably, diagnostic, staging and therapeutic expertise for a common type of cancer such as rectal cancer should be widespread and easily accessible for all patients.[27] An improvement project with a professional impetus is a valid alternative to centralisation.[15] In The Netherlands, a similar effort of structured surgical training and quality assurance in rectal cancer treatment has proved beneficial.[28 29] Methodologically sound and credible benchmarking is essential as clinicians will learn from their own performance and process statistics as well as from their colleagues with 'best practices'. The latter needs to be defined. In the case of the APE rate, a theoretical maximum limit could be set.[3 30] PROCARE is considering a different approach. Instead of informing all centres on the overall, nationwide median performances, procedural aspects, process and outcome indicators of centres performing in the better quartiles—for example up to percentile 50—will be offered to all participating centres to allow comparison with their own achievements. This procedure has been developed for anastomotic leakage after total mesorectal excision with coloanal anastomosis.[31] The presence of variability in APE or merged APE/HR rates indicates that there is room for improvement.

This study focused on the APE rate in patients with rectal cancer, aiming to illustrate the effect of risk adjusted benchmarking. A concern of focusing on the APE rate is that it could

Table 3 Abdominoperineal excision of the rectum, Hartmann resection and sphincter saving operation rates per age group (percentages in parenthesis)

Data	All patients	Patients aged <60 years	Patients aged 60–75 years	Patients aged >75 years
No of patients	3197	898/3197 (28)	1466/3197 (46)	833/3197 (26)
APE	673/3197 (21)	171/898 (19)	277/1466 (19)	225/833 (27)
HR	84/3197 (3)	6/898 (1)	23/1466 (2)	55/833 (7)
APE + HR	757/3197 (24)	177/898 (20)	300/1466 (20)	280/833 (34)
SSO	2440/3197 (76)	721/898 (80)	1166/1466 (80)	553/833 (66)

APE, abdominoperineal excision; HR, Hartmann resection; SSO, sphincter saving operation.

be seen as the major determinant of surgical quality and place surgeons under undue pressure to perform SSO when not indicated. It is evident that postoperative faecal incontinence reduces quality of life and that function saving is more important than sphincter saving per se. Furthermore, the patient's oncological outcome should not be compromised by an inappropriate SSO. Thus it is mandatory to monitor several quality of care indicators and interpret them in their proper context.

Author footnote
*The PROCARE steering group consists of delegates from all Belgian scientific organisations involved in the treatment of rectal cancer—that is, the Belgian Section of Colorectal Surgery, a section of the Royal Belgian Society of Surgery (C Bertrand, D De Coninck, M Duinslaeger, A Kartheuser, F Penninckx, J Van de Stadt, W Vaneerdeweg); the Belgian Society of Surgical Oncology (D Claeys); the Belgian Group for Endoscopic Surgery (D Burnon); the Belgian Society of Radiotherapy—Oncology (K Haustermans, P Scalliet, Ph Spaas); the Belgian Society of Pathology and the Digestive Pathology Club (P Demetter, A Jouret-Mourin, C Sempoux); the Belgian Society of Medical Oncology (W Demey, Y Humblet, E Van Cutsem); the Belgian Group for Digestive Oncology (S Laurent, E Van Cutsem, JL Van Laethem); the Royal Belgian Society of Radiology (E Danse, B Op de Beeck, P Smeets); the Société Royale Belge de Gastro-entérologie (M Melange, J Rahier); the Vlaamse Vereniging voor Gastro-enterologie Flemish Society for Gastroenterology (M Cabooter, P Pattyn, M Peeters); and the Belgian Society of Gastrointestinal Endoscopy (M Buset). Also represented are: the Belgian Professional Surgical Association (L Haeck, B Mansvelt, K Vindevoghel); the Foundation Belgian Cancer Registry (E Van Eycken); and the RIZIV/INAMI (J-P Dercq, A Thijs). FP chairs the PROCARE Steering Group. KB is a senior researcher at the Belgian Cancer Registry. SF is a statistician at I-Biostat, Katholieke Universiteit Leuven and Universiteit Hasselt, Belgium.

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