Influence of social deprivation and remoteness on the likelihood of sphincter amputation for rectal cancer: a high-resolution population-based study

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Abstract

Background: Medical care in rectal cancer is subject to social inequality. According to the last French guidelines, a 1-cm distal margin below the lower pole of the rectal tumor is now considered sufficient. This extends the limits of the current sphincter preservation gold standard. Like for others innovative technics, the dissemination of such technics is often subject to social and geographical inequalities. The objective was to analyze whether sphincter preservation in rectal cancer is subject to social or geographical inequality.

Methods: The odds of sphincter preservation was modeled by logistic regression among the 1453 patients in the Calvados digestive cancer registry between 01/01/1997 and 31/12/2016, by examining some of the variables that could influence it: social inequalities and geographical remoteness, sex, age and stage.

Results: 69.4% of the population received sphincter preservation. Patients in the more deprived quintiles had a significantly higher probability of having sphincter amputation (OR=1.469 (1.046-2.064). This result was no longer significant after adjustment on stage and travel-time. There was a dose-effect pattern of geographical remoteness on likelihood of sphincter preservation with a progressive increase in OR between patients living the nearest and the furthest from the reference center (p-trend = 0.0178).

Conclusion: This study shows that the probability of receiving sphincter preservation is influenced by the social environment and strongly influenced by remoteness. Although management guidelines have had a huge impact on the rates of sphincter preservation, they have not reduced the influence of the social and geographical environment on sphincter preservation

Introduction

Outcomes of rectal cancer patients have improved considerably thanks to optimal surgery by total mesorectal excision (TME) in conjunction with multidisciplinary team management and selective multimodal therapy (i.e., neo-adjuvant chemo-radiotherapy). Surgical techniques have extended the limits of sphincter preservation without impairing the oncological prognosis [1]. This progress has resulted in more patients receiving sphincter-preserving surgery (SPS) [2]. This improved coverage has allowed up to 80% of patients with rectal cancer to receive SPS.

Like for others innovative technics, the dissemination of such technics is often subject to social and geographical inequalities. Most studies dealing with social inequalities and in the surgical management of lower-tract digestive cancer have mainly focused on colon cancer[3]. Even if rectal cancer was less deeply studied, some studies found a correlation between variables representative of social status and sphincter amputation [4, 5].

Concerning geographical remoteness, evidences are weak and highly depend on health care system organization. Remoteness was reported as highly associated with disparities in management and survival for patients diagnosed with cancer in US or France [6, 7] whilst this association was not significant in England [8]. To date, the geographical inequality in rectal cancer care has received little attention.

This study explored the relative influence of social and geographical inequalities on the outcome of rectal cancer to determine whether socioeconomic deprivation and/or geographic remoteness are independent predictors of non-restorative rectal cancer surgery.

Methods

Population

Calvados is a French department in Normandy with an estimated population of 694,660 in 2016. Calvados has one teaching hospital and 12 other public and private centers. All patients with a rectal adenocarcinoma diagnosed in Calvados, registered in the Calvados digestive cancer registry between 01/01/1997 and 31/12/2016 (C20 8140/3 in International Classification of Diseases for Oncology 3) and treated by curative surgery were included in the present study (N= 1463) (Table 1).

Treatment procedures

The following data were extracted from the medical records of each patient in the registry: age at diagnosis; gender; timing and type of neoadjuvant radiotherapy and chemotherapy; sphincter-preserving surgery with or without stoma; abdomino-perineal excision; Hartmann's procedure; tumor, node, and/or metastasis stage by pathology report. When the procedure was not clear for sphincter status, we checked the report of the operation. Sphincter preservation was evaluated after the first surgery. Since reasons for no reestablishment were unknown, patients with stoma protection who did not have a reestablishment were classified as sphincter preservation. In the different models, risk of sphincter amputation was modeled. Since sphincter preservation is the gold standard, this class was chosen as the reference class.

Socioeconomic status

The European Deprivation Index (EDI) was used to assess the socioeconomic environment of each patient [9] and takes the French socio-economic situation into account. Patients are assigned to an IRIS (Ilots Regroupés pour l'Information Statistique) according to

their address. The IRIS is the smallest geographical area for which there is a statistical evaluation to estimate social deprivation. Once the patient was attached to an IRIS, their EDI could be established. We used the national quintile of distribution of this EDI, quintile 1 representing patients who live in the most privileged areas.

Travel time to reference care center

Travel time was estimated with the patient's address and defined as the shortest time to travel by car to the reference care center (regardless of where the patient received care), i.e. Caen University Hospital. A Geographical Information System (ArcGIS 10.5® – Esri France) associated with a roadmap database (Navstreets®, provided by HERE and Esri France) was used to estimate the travel time between the patient's residence and the reference care center. Travel time was estimated in minutes and divided into classes of 15 min.

Variables

Classification of stage was based on the TNM edition 7. The stage without metastasis and invaded lymph node (stage 0, stage I and stage II) was gathered. The stage III represent invaded lymph node (N+) and the stage IV metastasis (M+). Lymph node status was evaluated by pathology report. Metastasis was evaluated by radiological assessment before management. New recommendations on the management of rectal cancer were published by the French health authority on 01/02/2006 and include radiological assessment, neoadjuvant treatment, surgery, follow-up, and therapeutic advice for the surgical management of the sphincter. The change in care in this population became effective after 1 year so the reference data was 01/01/2007 to analyze the impact of the new recommendations.

Statistics

The results were obtained with a logistic regression model. All variables were analyzed with a univariate model (Table 1, model 0). Four models were then established: model 1 with age and gender, model 2 with stage added to model 1, model 3 with the new recommendations added to model 2 and model 4 with geographical deprivation added to model 3. Sex and age variables were forced into the multivariate models despite a non-significant p value, since we decided that they should be considered based on the literature and for clinical reasons.

Since only few missing values (reported in table 1) were present, we have used the listwise deletion method.

Results

Influence of deprivation on the likelihood of sphincter amputation

In the univariate model (Table 1, model 0), sphincter amputation was associated with deprivation. Patients in the more deprived quintiles had a significantly higher probability of having sphincter amputation than (OR=1.469 (1.046-2.064); p value 0.0266) compared to the other patients. After adjustment on age and sex, the association between deprivation and the likelihood of sphincter amputation was still significant (adjusted Odds-ratio: ORa=1.413 (1.003-1.992); p=0,048; Table 1, model M1). After adjustment on stage, deprived patients had a greater likelihood of having a sphincter amputation but, even if the magnitude of the effect remained stable, the p value was no longer significant for this last model (ORa=1.368 (0.967-1.936), p=0.076, Table 1 model M2). The adjustment on recommendation period had no effect on the association (Table 1, Model M3). Finally, after adjustment on travel-time, deprivation was not associated with the likelihood of sphincter amputation (ORa=1.276 (0.892-1.825), p=0,181, table 1, model M4). Travel times to reference care centre was the variable that had the greatest impact in the successive models with a net loss of significance of the p-value and a decrease in the effect.

Influence of remoteness on the likelihood of sphincter amputation

In univariate analysis, patients with a travel time to the reference center greater than 30 min had significantly more sphincter amputation than those who lived within 15 min of it. Patient with a travel time between 30 and 44 min had an OR=1.422 (IC 95 % [1.068-1.893]) and those who lived more than 45 min away had an OR=1.637 (IC95 % [1.082-2.479]). Travel time was linearly significantly associated with sphincter amputation (Table 1, model 0).

The multivariate model investigating geographic deprivation did not find any variable that fully explained the effect observed in the univariate model (Table 1, model 4). There was a dose-effect pattern of geographical remoteness on likelihood of sphincter preservation with a progressive increase in OR between patients living the nearest and the furthest from the reference center (respectively OR= 1. 06 (0. 80-1. 45); OR= 1. 36 (1. 02-1. 87) and OR = 1.46 (0.94-1.48) for each 15 min increase of travel-times, p-trend = 0.0178).

Discussion

The main finding of our study is that deprived patients and those living further from the center had less access to sphincter preservation, the current gold standard for the curative management of rectal cancer. Our study also highlighted that, although management guidelines have had a huge impact on the rates of sphincter preservation, they have not reduced the influence of the social and geographical environment on sphincter preservation

Concerning the influence of material deprivation, our results showed that the influence of material deprivation is partly explained by stage at presentation. However, the influence of stage on the likelihood of having a sphincter amputation could not fully explained the influence of deprivation. The influence of travel-times seems to be crucial in the explanation of the relationship between deprivation and the likelihood of having a sphincter amputation

Since neither clinical variables nor treatment variables nor deprivation could explain the influence of remoteness on sphincter amputation, geographical remoteness seems to be an independent prognostic factor of the likelihood of receiving sphincter preservation. The “dose-effect” pattern between sphincter amputation and travel time is a striking fact, even in an area for which the reference care center is located in the centroid of the area. Consequently, the influence of remoteness might be more important in more rural department.

It was not possible to obtain information on the surgeon who had performed the surgery, so we could not assess the influence of surgical volume on sphincter preservation. Indeed, since patients are treated in the closer hospital [10] for numerous reasons (mean age at diagnosis, proximity to family, health care pathways…), the explanation of our results by a

lower use of sphincter preservation in non-specialized hospitals is attractive. Future studies should take this variable into account in order to reveal the effect of surgeon and hospital.

Data regarding the impact of socio-economic status on rectal cancer are to date scarce. European data mainly come from the National Bowel Cancer Project study [5], and from the Swedish rectal cancer registry. The British administrative database initially suggested an association between socioeconomic deprivation and abdominoperineal excision for rectal cancer. However, given the lack of data on demographic factors and tumor characteristics, it was not possible to demonstrate an independent relation between socio-economic deprivation and non-restorative rectal cancer surgery [5]. Results from Swedish rectal cancer registry, based on 7433 patients suggested an association with socioeconomic factors [11].

A systematic literature review showed a negative impact of stoma on quality of life in colorectal cancer [12]. Even if it is less clear in rectal cancer due to the complications after surgery with sphincter preservation, the latter remains the gold standard when feasible. In conclusion, our study demonstrates that the probability of receiving sphincter preservation is highly influenced by the patient's social and geographical environment. Therefore, health care in France requires a new form of organization, where high-volume surgeons should practice surgery in low-volume hospitals to reduce the geographical gap in management and survival. The impact of this recommendation should be monitored over the coming years.

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Table 1: Influence of clinical and demographic variables on the probability of sphincter amputation for patients diagnosed in Calvados between 1997 and 2016 after successive adjustments (logistic regressions)

	SP*	No SP*	Univariate analysis				M1 : M0 + sexe and Age				M2 : M1 + Stage				M3 : M2 + Period				M4 : M3 + travel time			
	N	N	OR	IC		p	OR	IC		p	OR	IC		p	OR	IC		p	OR	IC		p
EDI																						
Quintile 1	50	157	1			0,027	1			0,048	1			0,077	1			0,080	1			0,181
Quintile2+3+4+5	394	842	1,47	1,05	2,06		1,41	1,00	1,99		1,37	0,97	1,94		1,37	0,96	1,95		1,28	0,89	1,83	
Unknown	4	16																				
Age																						
<60 years	109	264	1			0,012	1			0,021	1			0,017	1			0,024	1			0,028
60-69 years	97	300	0,76	0,55	1,05		0,76	0,55	1,04		0,80	0,57	1,11		0,83	0,60	1,17		0,83	0,60	1,16	
70-79 years	162	305	1,28	0,95	1,72		1,26	0,93	1,69		1,27	0,94	1,72		1,20	0,88	1,64		1,21	0,89	1,65	
>80 Years	80	146	1,30	0,91	1,85		1,29	0,90	1,84		1,35	0,94	1,94		1,40	0,97	2,03		1,38	0,95	2,00	
Gender																						
Men	275	622	1			0.9702	1			0,449	1			0,593	1			0,649	1			0,675
Women	173	393	1,00	0,79	1,25		0,91	0,72	1,16		0,94	0,74	1,19		0,95	0,74	1,21		0,95	0,74	1,21	
Stage																						
1+2	241	581	1			0,172					1			0,175	1			0,318	1			0,347
3 vs 1+2	120	236	1,23	0,94	1,60						1,23	0,94	1,61		1,19	0,90	1,56		1,18	0,90	1,55	
4 vs 1+2	71	134	1,28	0,92	1,77						1,28	0,92	1,78		1,22	0,88	1,71		1,21	0,87	1,70	
Unknown	16	64																				
Period																						
before recommandation	293	479	1			<.0001									1			<,0001	1			<,0001
after recommandation	155	536	0,47	0,38	0,60										0,47	0,37	0,59		0,47	0,37	0,59	
Travel time																						
<15 min	139	376	1			0,003													1			0,018
15-29 min	130	310	1,13	0,86	1,51														1,07	0,80	1,45	
30-44 min	133	253	1,42	1,07	1,89														1,38	1,02	1,87	
≥45 min	46	76	1,64	1,08	2,48														1,46	0,94	2,28	
Unknown	1	16																				

Sp : Sphincter preservation

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