

Physicians' awareness of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy for colorectal cancer carcinomatosis

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Background: Recent trials have shown that cytoreductive surgery and heated intraperitoneal chemotherapy (S+HIPEC) for colorectal cancer carcinomatosis (CRC-C) leads to 5-year, disease-free survival rates of more than 30%. Since these data represent a substantial change in the management of CRC-C, the objectives of this study were to determine physicians' awareness of S+HIPEC for CRC-C and physician characteristics predictive of awareness of S+HIPEC for CRC-C.

Methods: This study was a mailed, cross-sectional survey of general surgeons and medical oncologists in Ontario.

Results: The response rate was 44.0% (214 of 487). Most respondents were men and younger than 50 years. There was an even split between those at academic and community hospitals. Overall, 46% of respondents were aware of S+HIPEC for CRC-C, and multivariate analysis showed that there were no physician characteristics predictive of awareness of S+HIPEC for CRC-C.

Conclusion: Physician awareness of S+HIPEC for CRC-C is low. Therefore, strategies to improve patient and physician knowledge about S+HIPEC for CRC-C are important to ensure appropriate treatment for patients.

Contexte : Des essais récents ont démontré que la chirurgie de réduction tumorale combinée à la chimiothérapie intrapéritonéale hyperthermique (S+HIPEC) contre la carcinomatose du cancer colorectal (C-CCR) produit des taux de survie sans maladie de 5 ans qui dépassent 30 %. Comme ces données représentent une modification importante de la prise en charge de la C-CCR, l'étude visait à déterminer si les médecins connaissent la technique S+HIPEC contre la C-CCR et les caractéristiques des médecins qui prédisent une connaissance de la technique S+HIPEC contre la C-CCR.

Méthodes : L'étude consistait en un sondage transversal postal mené auprès de chirurgiens généraux et de médecins oncologues de l'Ontario.

Résultats : Le taux de réponse a atteint 44,0 % (214 sur 487). La plupart des répondants étaient des hommes de moins de 50 ans. La répartition entre les hôpitaux universitaires et les hôpitaux communautaires était égale. Dans l'ensemble, 46 % des répondants connaissaient la technique S+HIPEC contre la C-CCR et une analyse à variables multiples a montré qu'il n'y avait pas de caractéristiques des médecins qui pouvaient prédire la connaissance de la technique S+HIPEC contre la C-CCR.

Conclusion : Les médecins connaissent peu la technique S+HIPEC contre la C-CCR. Des stratégies visant à améliorer la connaissance de la technique S+HIPEC contre la C-CCR chez les patients et les médecins sont importantes pour assurer le traitement approprié des patients.

Colorectal cancer carcinomatosis (CRC-C) affects about 10% of all patients with colorectal cancer, and it is the second most common cause of death in these patients after metastatic liver disease.¹ Until recently, CRC-C was considered incurable, and cytoreductive surgery combined with hyperthermic intraperitoneal surgery (S+HIPEC) was reserved only for appendiceal tumours or pseudomyxoma.² However, in 2003 a randomized controlled trial (RCT) showed a significant improvement in median survival with

S+HIPEC for CRC-C relative to best systemic chemotherapy (22.4 mo v. 12.6 mo, $p = 0.032$). This trial also showed that median survival was significantly better in patients with low-volume disease (> 29 mo v. 5.4 mo, $p < 0.001$) and in those who had a macroscopically complete cytoreduction ($p < 0.001$). After 8 years, the 5-year survival was 45% in patients who achieved a macroscopically complete cytoreduction.³ Based on this RCT and 10 other phase II trials, an international consensus statement was published by the Society of Surgical Oncology (SSO) recommending the use of S+HIPEC for appropriately selected patients with CRC-C.⁴ Despite this evidence supporting S+HIPEC for CRC-C, there has been little systematic investigation into physicians' awareness of S+HIPEC for CRC-C. This is important, since lack of physician awareness may result in eligible patients with CRC-C not being referred for S+HIPEC.^{5,6} Physician awareness is the first sequential step necessary for successful implementation of a new intervention into clinical practice.^{7,8}

Therefore, the objectives of the present study were, first, to determine physicians' awareness of S+HIPEC for CRC-C and, second, to determine physician characteristics predictive of awareness of S+HIPEC for CRC-C.

METHODS

The research ethics board at our institution approved our study protocol. This study was a cross-sectional, mailed survey of general surgeons and medical oncologists in the province of Ontario, Canada. The population of Ontario is approximately 13 million, and health care is publicly funded by the government.

Eligible physicians (general surgeons, medical oncologists) were identified using the website of the province's medical licensing body, the College of Physicians and Surgeons of Ontario (CPSO). The CPSO website is publicly accessible, updated annually and contains the name, address and specialty of all licensed physicians in Ontario. We considered physicians to be eligible to participate if they were registered as active general surgeons or medical oncologists working as full-time staff members at any Ontario hospital.

We developed a 12-item questionnaire to obtain demographic information (5 items on a categorical scale) and to assess physicians' awareness of S+HIPEC and their perceived barriers to the use of this treatment for pseudomyxoma and CRC-C (7 items on a categorical scale). Since S+HIPEC has been an accepted treatment for pseudomyxoma for more than 10 years, we expected that physicians' awareness of S+HIPEC for pseudomyxoma would be greater than for CRC-C. Therefore, we used physicians' awareness of S+HIPEC for pseudomyxoma as the baseline to compare physicians' awareness of S+HIPEC for CRC-C. The survey was pilot-tested among 5 health care professionals to ensure face validity and comprehension.

Data collection

We collected data using the Dillman method.⁹ Study packages contained the survey; a personalized, signed cover letter; and a stamped and addressed return envelope. Six weeks after the initial mail-out, a second package was mailed to nonresponders. Six weeks after the second mail-out, we contacted the remaining nonresponders by telephone as a final reminder to complete the survey.

Statistical analysis

Descriptive statistics are presented as percentages and frequencies; χ^2 tests of association were used to compare respondent characteristics and awareness of S+HIPEC for pseudomyxoma and CRC-C. We performed Fisher exact tests when more than 25% of the subgroups examined (cells) were populated by fewer than 5 respondents. Logistic regression was used to model the physicians' awareness of S+HIPEC for pseudomyxoma and CRC-C on physician characteristics. We conducted Hosmer–Lemeshow goodness of fit tests to verify the appropriateness of each model. All analyses were conducted using SAS software version 9.2¹⁰

RESULTS

We mailed the survey to 658 Ontario physicians (general surgeons, medical oncologists). Of these, 62 surveys were returned undelivered, and these physicians were not subsequently contacted with a follow-up telephone call. In all, 334 surveys were returned; of these, 214 were complete and 41 were ineligible (retirement [$n = 7$], not currently treating patients with pseudomyxoma and did not complete the

Table 1. Demographic characteristics of survey respondents

Characteristic	Group; no. (%)*			p value, GS v. MO
	All, n = 214	GS, n = 185	MO, n = 29	
Response rate, %	44.0	46.9	31.6	0.007
Sex				
Female	53 (24.8)	40 (21.6)	13 (44.8)	0.007
Male	161 (75.2)	145 (78.4)	16 (55.2)	
Years in practice				
≤ 10	91 (42.5)	80 (43.2)	11 (37.9)	0.59
> 10	123 (57.5)	105 (56.8)	18 (62.1)	
Age, yr				
≤ 50	136 (64.2)	115 (62.8)	21 (72.4)	0.32
> 50	76 (35.9)	68 (37.2)	8 (27.6)	
Type of practice				
Academic	98 (45.8)	76 (41.1)	22 (75.9)	0.001
Community	116 (54.2)	109 (58.9)	7 (24.1)	
Fellowship training				
Yes	176 (83.0)	147 (80.3)	29 (100.0)	0.006
No	36 (17.0)	36 (19.7)	0 (0.0)	

GS = general surgeon; MO = medical oncologist.
*Unless otherwise indicated.

survey [$n = 34$]), and 79 declined to participate. Therefore, the 103 ineligible surveys (41 ineligible and 62 undelivered) and an estimated 68 ineligible surveys (nonresponse) were removed from the denominator, as per the American Association of Public Opinion and Research (AAPOR) response rate guidelines, for a corrected response rate of 44.0% (214 of 487).¹¹ The response rate for general surgeons was significantly higher than for medical oncologists (47% general surgeons v. 32%, $p = 0.007$; Table 1). Compared with responders, nonresponders were similar with respect to sex (75% v. 81% were men, $p = 0.08$), but were significantly more likely to have been in practice for more than 20 years (44% v. 28%, $p < 0.001$) and be medical oncologists (24% v. 14%, $p = 0.004$).

The respondents' demographic characteristics are shown in Table 1. Most respondents were men (75%), younger than 50 years (64%) and fellowship-trained (83%). There was a fairly even split between physicians who had been working for less than or more than 10 years and between those working in community and academic hospitals. Overall, medical oncologists were more likely than general surgeons to be women, practise in academic hospitals and be fellowship-trained.

The overall results of the survey showed that while 86% of the respondents were aware of S+HIPEC for pseudomyxoma, only 46% were aware of this treatment for CRC-C (Table 2). General surgeons were significantly more likely to be aware of S+HIPEC for pseudomyxoma than medical

Table 2. Physicians' awareness of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (S-HIPEC) for pseudomyxoma and colorectal cancer carcinomatosis (CRC-C)

Physician awareness	Group; no. (%)			<i>p</i> value, GS v. MO
	All, $n = 214$	GS, $n = 185$	MO, $n = 29$	
1. To your knowledge, what treatment options are currently available for pseudomyxoma? (check all that apply)*				
Chemotherapy alone	63 (29.4)	54 (29.2)	9 (31.0)	0.83
Cytoreductive surgery alone	65 (30.4)	48 (26.0)	17 (58.6)	< 0.001
Cytoreductive surgery and HIPEC	184 (86.0)	163 (88.1)	21 (72.4)	0.039
2. To your knowledge, what treatment options are currently available for CRC-C? (check all that apply)*				
Chemotherapy alone	147 (68.7)	125 (67.6)	22 (75.9)	0.52
Cytoreductive surgery alone	30 (14.0)	24 (13.0)	6 (20.7)	0.26
Cytoreductive surgery and HIPEC	99 (46.3)	87 (47.0)	12 (41.4)	0.69
3. Is there a program at your centre that specializes in treating patients with pseudomyxoma and/or CRC-C?				
Yes	28 (13.3)	26 (14.2)	2 (7.4)	0.010
No	167 (79.5)	148 (80.9)	19 (70.4)	
Don't know	15 (7.1)	9 (4.9)	6 (22.2)	
4. On average how many patients with pseudomyxoma and/or CRC-C do you see per year?				
0	28 (13.1)	21 (11.4)	7 (24.1)	0.09
1-5	33 (15.4)	28 (15.1)	5 (17.2)	
6-10	13 (6.1)	10 (5.4)	3 (10.3)	
> 10	140 (65.4)	126 (68.1)	14 (48.3)	
5. Where do you refer patients for treatment of pseudomyxoma and CRC-C?†				
Other specialist at my centre	60 (32.6)	52 (31.9)	8 (36.4)	0.015
Other centre in my province	98 (53.3)	90 (55.2)	8 (36.4)	
Other centre in another province	16 (8.7)	15 (9.2)	1 (4.6)	
Out of country	2 (1.1)	2 (1.2)	0 (0)	
Other	10 (5.4)	5 (3.1)	5 (22.7)	
6. What reasons prevent you from referring patients to a specialist or specialist centre? (check all that apply)*†				
Refer all patients	30 (16.1)	29 (17.7)	1 (4.6)	0.21
Patient characteristics/comorbidity	88 (47.3)	81 (49.4)	7 (31.8)	0.17
Lack of evidence to support HIPEC	14 (7.5)	9 (5.5)	5 (22.7)	0.014
Not aware of any programs	38 (20.4)	31 (18.9)	7 (31.8)	0.17
Other	6 (3.2)	4 (2.4)	2 (9.1)	0.15
7. What barrier, if any, have you encountered when referring these patients? (check all that apply)*†				
No barriers	30 (16.1)	29 (17.7)	1 (4.6)	0.21
Long waiting lists	34 (18.3)	31 (18.9)	3 (13.6)	0.77
No specialist and/or centre	35 (18.8)	28 (17.1)	7 (31.8)	0.14
No funding for treatment out of province	6 (3.2)	5 (3.1)	1 (4.6)	0.54
Patient preference for treatment	41 (22.0)	36 (22.0)	5 (22.7)	> 0.99
Other	16 (8.6)	14 (8.6)	2 (9.2)	> 0.99

GS = general surgeon; MO = medical oncologist.
 *Respondents could indicate more than 1 option.
 †Percentages calculated only from physicians seeing patients with pseudomyxoma or CRC-C ($n = 186$).

oncologists (88% general surgeons v. 72% medical oncologists, $p = 0.039$). There was no significant difference in the level of awareness between general surgeons and medical oncologists (47% general surgeons v. 41%, $p = 0.69$) for S+HIPEC for CRC-C.

On average the respondents indicated that they saw more than 10 patients with pseudomyxoma and/or CRC-C every year, and most respondents referred patients to another centre in the province. Eighty percent of the respondents indicated that they did not have a specialized treatment program for pseudomyxoma or CRC-C at their centre. Medical oncologists were significantly more likely than general surgeons to be unaware of a specialized treatment program at their centre (22.2% medical oncologists, v. 4.9% general surgeons, $p = 0.010$).

The respondents indicated that the main reason for not referring patients for treatment were, first, patient characteristics and comorbidities (47.3%) and, second, lack of awareness of existing treatment programs (20.4%). Medical oncologists were significantly more likely than general surgeons to indicate that they did not refer patients owing to lack of evidence for S-HIPEC (medical oncologists 22.7 v. general surgeons 5.5%, $p = 0.014$).

With respect to barriers to referring patients for treatment, 16% of respondents indicated that there were no barriers, whereas 18% indicated long waiting lists and 19% indicated no specialized physicians and/or centres as barriers. Twenty-two percent of respondents also indicated that patient preferences for treatment was a significant barrier to referral.

We performed multivariate logistic regression analysis to identify physician characteristics predictive of awareness of S+HIPEC for both pseudomyxoma and CRC-C (Table 3). Of the independent variables selected (sex, years in practice, type of practice, specialty and existence of HIPEC program at respondent's centre), specialty and working in an academic hospital were predictive of physician awareness for S+HIPEC for pseudomyxoma. Overall, university-based physicians were 2.7 times (95% confidence interval [CI] 1.09–6.73) more likely to be aware of S+HIPEC than community-based physicians, and general surgeons were 3.65 times (95% CI 1.27–10.48) more likely to be aware of S+HIPEC than medical oncologists. There were no physician characteristics predictive of awareness of S+HIPEC for CRC-C.

DISCUSSION

Our study assessed physician awareness of S+HIPEC for CRC-C in the province of Ontario. While 86% of respondents were aware of S+HIPEC for pseudomyxoma, only 46% were aware of S+HIPEC for CRC-C. These findings suggest that physicians' awareness of S+HIPEC for CRC-C is low in the province of Ontario. Since lack of awareness may result in eligible patients with CRC-C not being referred for S+HIPEC, strategies to improve physician awareness are critical to ensure physician adoption of this treatment and appropriate referral of patients. Based on these survey results, educational strategies to improve

Table 3. Predictors of physician awareness of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (S-HIPEC) for pseudomyxoma and colorectal cancer carcinomatosis (CRC-C)

Predictors	Pseudomyxoma, n = 214				CRC-C, n = 214			
	No. (%)*	Crude p value	Adjusted OR (95% CI)	Adjusted p value	No. (%)*	Crude p value	Adjusted OR (95% CI)	Adjusted p value
Sex		0.24		0.26		0.041		0.09
Male	141 (87.6)		1.73 (0.66–4.49)		81 (50.3)		1.88 (0.91–3.85)	
Female	43 (81.1)		1.00 (Ref)		18 (34.0)		1.00 (Ref)	
Years in practice		0.48		0.26		0.17		0.47
≤ 10	104 (84.6)		1.67 (0.68–4.07)		62 (50.4)		0.80 (0.44–1.46)	
> 10	80 (87.9)		1.00 (Ref)		37 (40.7)		1.00 (Ref)	
Type of practice		0.14		0.032		0.08		0.08
Academic	88 (89.8)		2.71 (1.09–6.73)		52 (53.1)		1.72 (0.93–3.18)	
Community	96 (82.8)		1.00 (Ref)		47 (40.5)		1.00 (Ref)	
Specialty		0.039		0.016		0.69		0.36
General surgery	163 (88.1)		3.65 (1.27–10.48)		87 (47.0)		1.53 (0.62–3.80)	
Medical oncology	21 (72.4)		1.00 (Ref)		12 (41.4)		1.00 (Ref)	
Currently aware of program offering treatment at own centre†		0.017				0.34		0.66
Yes	28 (100)				15 (53.6)		1.21 (0.51–2.89)	
No	153 (84.1)				80 (44.0)		1.00 (Ref)	

CI = confidence interval; OR = odds ratio.
 *% of correlate. For example, 87.6% of male respondents are aware of S+HIPEC compared with 81.1% of female respondents; however, this difference is not statistically significant.
 †Program offering treatment could not be examined as a predictor in the model for pseudomyxoma, given that 100% of physicians with access to such centres reported knowledge of or recommending cytoreductive surgery and HIPEC.

physician awareness about the effectiveness of S+HIPEC for CRC-C are necessary. Since the principles of adult learning include self-direction and emphasis on real life situations, strategies with the greatest chance of success include reinforcement, sequential activities and interaction among the participants and involve opinion leaders.¹² For this purpose, a series of Internet or webinar case presentations followed by review of the evidence and online discussion among physicians and opinion leaders may be an excellent format to improve awareness of S+HIPEC for CRC-C.¹²

At the time of the survey, while Nova Scotia (Halifax), Quebec (Montréal) and Alberta (Calgary and Edmonton) had specialized centres for HIPEC, there were no specialized centres offering HIPEC in Ontario. Therefore, it was not surprising that only a small proportion of the respondents (i.e., 13.3%) indicated that there was a specialized treatment program for these patients at their centre. Despite this, only 20% of respondents indicated lack of awareness of existing treatment programs and only 19% indicated lack of a specialist or specialty centre as a barrier to referral of these patients. Furthermore, regression analysis did not show that current awareness of an existing treatment program at the respondent's own centre was predictive of physician awareness of S+HIPEC as a treatment option for CRC-C. This may be because, at the time of the survey, none of these treatment programs was routinely offering S+HIPEC for CRC-C, but it is also likely because of our small sample size and inadequate power to detect important differences.

Interestingly, almost 50% of the respondents indicated that the main reason for not referring patients for treatment were patient characteristics and comorbidities. These findings were important to our centre, since it was designated as the provincial centre for S+HIPEC for pseudomyxoma and CRC-C in February 2011 after completion of our survey. Since we found both a lack of awareness about existing programs and a lack of awareness of appropriate selection of patients, our group developed a referral checklist for referring physicians that provides an explicit list of indications and contraindications for S+HIPEC for pseudomyxoma and CRC-C to assist physicians with the referral process (Box 1).

It is interesting that medical oncologists were less likely than general surgeons to consider S+HIPEC as a treatment option for pseudomyxoma and more likely to indicate there was a lack of evidence to support the use of this treatment. With respect to CRC-C, the overall awareness of S+HIPEC was much lower, and there were no differences between general surgeons and medical oncologists. Therefore, educational strategies that target a multidisciplinary audience, including medical oncologists, need to be strongly considered. Furthermore, since the management of these patients is complex, strategies to improve communication among general surgeons, medical oncologists and family physicians will be critical to improve awareness and adoption of S+HIPEC for CRC-C.

Finally, the respondents indicated that patient preferences were one of the main barriers to referral of CRC-C patients for S+HIPEC. This is certainly an issue that needs to be explored in future studies, since there has been little systematic investigation of patients' preferences for S+HIPEC or the reasons for why they would choose or not choose S+HIPEC. In this regard, development of decision-support interventions or a decision aid for both physicians and patients is warranted and has been shown to be an effective strategy to assist treatment decision making and improve patient outcomes in other cancer settings.^{13,14}

Limitations

The main limitation of this study was the low overall response rate of 44%. Although there was no difference in sex between responders and nonresponders, fewer physicians in practice for more than 20 years and fewer medical oncologists responded to the survey, which may have led to important response bias, thus limiting the validity and generalizability of our results. Furthermore, these data were based on self-report rather than observed behaviour and therefore may not accurately reflect what physicians may actually recommend in their clinical practices. Finally, although we included both general surgeons and medical oncologists in the survey, we did not include primary care physicians, and this information would have been useful to assess their level of awareness with S+HIPEC and plan targeted educational interventions in this physician population.

CONCLUSION

Physician awareness of S+HIPEC for CRC-C in Ontario is low. Our results suggest that educational strategies to

Box 1. Referral checklist for physicians: indications and contraindications for cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (S+HIPEC) for pseudomyxoma and colorectal cancer carcinomatosis (CRC-C) at our provincial centre

Inclusion criteria

- Medically fit for surgery
- Younger than 70 years
- Diagnosis of CRC-C (resected or resectable), appendix neoplasms or peritoneal mesothelioma
- Body mass index < 35
- Completely resectable disease

Exclusion criteria

- Primary cancer: gastric, pancreatic, breast, cholangiocarcinoma, gastrointestinal stromal tumour
- High grade and/or signet ring colorectal cancer
- Malignant small bowel obstruction
- Ureteric obstruction from tumour
- Extra-abdominal metastases
- Retroperitoneal lymphadenopathy
- Progression of disease while on chemotherapy

improve both patient and physician awareness about S+HIPEC are necessary to ensure that eligible patients with CRC-C are appropriately referred for S+HIPEC.

Competing interests: None declared.

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