Quality of life following cytoreductive surgery and hyperthermic intraperitoneal chemotherapy: a Canadian experience

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Background: Cytoreductive surgery (CRS) combined with hyperthermic intraperitoneal chemotherapy (HIPEC) is an effective treatment for select peritoneal surface malignancies, offering a survival benefit. However, the procedure can substantially impact patients' quality of life (QoL) owing to its physiologic and functional effects. We sought to evaluate QoL trajectories over 12 months following CRS/HIPEC and to identify factors influencing outcomes.

Methods: A prospective cohort study was performed including patients undergoing CRS/HIPEC between January 2018 and July 2022. Quality of life was assessed preoperatively and at 3, 6, and 12 months postoperatively using the European Organisation for Research and Treatment of Cancer (EORTC) QLQ-C30 and QLQ-CR29 questionnaires. Qualitative data from open-ended responses were analyzed thematically.

Results: Twenty-five patients were included in the study. Global health scores declined at 3 months ($p = 0.024$) but returned to near baseline by 12 months. Physical function showed similar recovery, and cognitive function improved significantly by 6 months ($p = 0.017$). Sexual function showed increased interest ($p < 0.001$) but worsening symptoms. Key QoL predictors included age, sex, postoperative complications, systemic therapy, and recurrence. Family support, medical care, and active lifestyles positively influenced recovery, whereas prognosis concerns and physical limitations were negative factors.

Conclusion: Quality of life after CRS/HIPEC showed dynamic recovery over 12 months and was influenced by clinical, demographic, and psychosocial factors, emphasizing the need for comprehensive perioperative support.

Contexte : La chirurgie cytoréductrice (CC) associée à la chimiothérapie hyperthermique intrapéritonéale (CHIP) est un traitement efficace contre certaines tumeurs de la surface péritonéale et qui offre un bienfait sur le plan de la survie. Ce traitement peut cependant avoir des répercussions importantes sur la qualité de vie des patients et patientes en raison de ses effets physiologiques et fonctionnels. Nous avons voulu évaluer les trajectoires relatives à la qualité de vie pendant les 12 mois qui suivent un traitement par l'association CC-CHIP et repérer les facteurs qui ont une influence sur les résultats.

Méthodes : On a effectué une étude de cohorte prospective comprenant des patients et patientes ayant reçu le traitement d'association CC-CHIP entre janvier 2018 et juillet 2022. On a évalué la qualité de vie avant l'intervention et à 3, à 6 et à 12 mois après celle-ci au moyen des questionnaires QLQ-C30 et QLQ-CR29 du European Organisation for Research and Treatment of Cancer (EORTC). On a analysé les données qualitatives des réponses ouvertes par thème.

Résultats : Vingt-cinq patients et patientes ont participé à l'étude. Les scores relatifs à l'état de santé général s'étaient détériorés à l'évaluation de 3 mois ($p = 0{,}024$), mais étaient presque revenus aux valeurs initiales à l'évaluation de 12 mois. On a noté un rétablissement semblable sur le plan de la capacité fonctionnelle, de même qu'une amélioration importante de la fonction cognitive à l'évaluation de 6 mois ($p = 0{,}017$). Les patients et patientes ont signalé une augmentation du désir sur le plan du fonctionnement sexuel ($p < 0{,}001$), mais une aggravation des symptômes. Parmi les facteurs prédictifs clés liés à la qualité de vie, citons l'âge, le sexe, les complications postopératoires, le traitement à action générale et la récidive. Le soutien de la famille, les soins médicaux et un mode de vie actif ont influencé de façon positive le rétablissement, alors que les préoccupations relatives au pronostic et les limites physiques constituaient des facteurs négatifs.

Conclusion : On a noté un rétablissement dynamique sur 12 mois de la qualité de vie à la suite d'un traitement par l'association CC-CHIP. Les facteurs cliniques, démographiques et psychosociaux ont eu une influence sur le rétablissement, ce qui souligne le besoin d'offrir un soutien périopératoire complet.

Cytoreductive surgery (CRS) combined with hyperthermic intraperitoneal chemotherapy (HIPEC) has emerged as a standard of care for select peritoneal surface malignancies, including pseudomyxoma peritonei and colorectal peritoneal carcinomatosis (PC).[1,2] This therapeutic strategy is also increasingly being explored for other peritoneal malignancies, such as gastric cancer and rare pathological conditions.[3,4] Compared with systemic therapy alone, CRS/HIPEC offers superior survival outcomes in PC of certain malignancies (e.g., colon, appendix),[5,6] providing opportunities for durable disease control and extended survivorship.[7,8] However, the approach is a highly complex intervention, often associated with significant morbidity that can adversely affect patients' quality of life (QoL).[9]

The selection of candidates for CRS/HIPEC is typically informed by a range of clinical factors, including patient comorbidities, tumour biology, disease burden, response to systemic therapy, and the presence or absence of extraperitoneal metastases.[10] While baseline functional status and the capacity to perform daily activities are frequently considered in decision-making, baseline QoL is not routinely incorporated as a primary selection criterion.[11] Nevertheless, existing evidence suggests that baseline QoL is a critical determinant of treatment success and substantially influences treatment outcomes.[4,12] Studies assessing QoL following CRS/HIPEC have reported that, although QoL is initially diminished after the procedure, most metrics return to baseline levels within 6 to 12 months postoperatively.[13–16]

The present study aimed to evaluate QoL trajectories over the first year following CRS/HIPEC and to identify key factors influencing QoL during this period. Furthermore, we sought to capture patient perspectives and patient reported outcomes on these changes in QoL to enhance understanding of their experience.

METHODS

Study design and population

This pilot prospective cohort study was conducted at a single HIPEC-specialized tertiary centre. All eligible patients who met the inclusion criteria were included in the study. To be eligible, patients had to be 18 years or older and scheduled to undergo CRS/HIPEC at the facility between January 2018 and July 2022. Currently, our centre offers CRS/HIPEC to patients with peritoneal metastasis from colorectal cancer, appendiceal neoplasm, and small bowel adenocarcinoma. Patients who were either unwilling or unable to complete the study questionnaires were excluded.

Patient characteristics, operative details, and surgical outcomes were collected prospectively. Postoperative outcomes (complication rate, length of stay, 30-day readmission rate, and cancer recurrence rate) were selected based on prior literature on their effect on QoL.[4,11,14]

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of the University of Calgary (HREBA. CC-17–0484), and informed consent was obtained from all participants before their inclusion in the study.

Study questionnaires

Data were collected using the European Organisation for Research and Treatment of Cancer Core Quality of Life Questionnaire (EORTC QLQ-C30)[17] and the European Organisation for Research and Treatment of Cancer Colorectal Quality of Life Questionnaire (EORTC QLQ-CR29).[18] Although not specifically validated for patients undergoing CRS/HIPEC, these questionnaires were selected based on a prior study that used them to assess QoL in patients undergoing CRS/HIPEC.[19] Currently, no validated tool exists that is specifically designed to assess QoL in this patient population. The QLQ-C30 and QLQ-CR29 questionnaires align with the most common types of resections performed in our CRS/HIPEC cohort (colon and small bowel).

The QLQ-C30 consists of 30 items addressing global health, functional scales (physical, role, cognitive, emotional, and social functioning), a symptom scale, and a single question concerning financial difficulties. Most questions in the QLQ-C30 are scored on a scale from 1 ("not at all") to 4 ("very much"), with the exception of 2 global health questions that are rated on a scale of 1 to 7. The QLQ-CR29 consists of 29 items assessing symptoms (gastrointestinal, urinary, pain, and others) and functional aspects (sexual function and body image) related to colorectal surgery and treatment. It differentiates between patients with and without a stoma, and between men and women for sexual functioning. Most questions are rated on a scale from 1 ("not at all") to 4 ("very much"), except for 1 "yes" or "no" question about the presence of a stoma. All questions assess patient experiences over the previous week, except for a question on sexual functioning that evaluates the previous 4 weeks.

Participants were asked to complete the questionnaires at 4 specific time points: preoperatively, and at 3, 6, and 12 months following CRS/HIPEC. All questionnaires were completed by patients at scheduled visits with the CRS/HIPEC team; the patients were left to complete the questionnaires on their own, and a team member was available for assistance if needed. Most patients completed the initial questionnaires and consent in clinic; however, others mailed them back. For the follow-up questionnaires and the qualitative assessment (at 3, 6, and 12 months), the majority were mailed to the patients, and returned by mail. The patients' responses were converted into percentage scores following the guidelines provided in the questionnaire instruction manual. For global health status, functional scores, and sexual function (interest), higher scores indicate better function or QoL; conversely, for symptom scales, financial status, and sexual function (symptoms), higher scores reflect worse symptoms or a lower QoL.

Patients were also given an optional questionnaire with 3 open-ended questions addressing factors influencing QoL (Appendix 1, available at www.canjsurg.ca/lookup/doi/10.1503/cjs.006125/tab-related-content), which was used for the qualitative assessment.

Statistical analysis

Demographic data and scale scores were summarized using descriptive statistics. Comparisons were made using the Student t test and one-way analysis of variance (ANOVA). Pearson correlation coefficients were used to assess relationships between variables. Multiple regression analysis was conducted for inferential statistics. Results were considered statistically significant at $p < 0.05$. All statistical analyses were performed using Statistical Package for Social Sciences version 29.

Qualitative assessment

Patients' answers to the optional open-ended questions (Appendix 1) were transcribed verbatim for thematic analyses. Alphanumeric identifiers were used to protect participant confidentiality. Content and thematic analyses were performed using an iterative process of coding to identify recurrent concepts and categories without the use of qualitative software. The emergent themes were established through multiple rounds of conversations and comparisons until saturation was reached.

RESULTS

Patient demographics and perioperative details

A total of 25 patients were included in the study. During the same period a total of 103 patients underwent CRS/HIPEC, making the participation rate 24.3%. The mean age of the cohort was 53.4 ± 11.4 years, with 16 (64%) being female. The majority of patients were diagnosed with appendiceal mucinous neoplasm ($n = 11$) or colonic adenocarcinoma ($n = 9$). The median Peritoneal Carcinomatosis Index (PCI) was 12 (range 0 to 39), and the rate of complete cytoreduction (CC) was 96%. Stoma was created in 5 (20%) patients during their CRS/HIPEC. Postoperative complications were observed in all patients, though most were classified as Clavien–Dindo grade 1 or 2 ($n = 20$ [80%]). There were no postoperative (90 d) deaths. Neoadjuvant systemic therapy was administered to 13 of 16 (81.3%) eligible patients, and 10 of 16 (62.5%) received adjuvant systemic therapy. The median hospital stay was 14 (range 7 to 69) days, with 3 patients requiring readmission within 30 days of discharge. Table 1 shows the patient characteristics and surgical details.

Table 1. Demographic and surgical characteristics of patients undergoing CRS/HIPEC

Characteristic	No. (%)*
Age, mean ± SD, yr	53.4 ± 11.4
Sex	
Male	9 (36.0)
Female	16 (64.0)
Intraoperative Peritoneal Carcinomatosis Index score, median (range)	12 (0–39)
Diagnosis	
Appendiceal mucinous neoplasm	11 (44.0)
Colon adenocarcinoma	9 (36.0)
Appendiceal adenocarcinoma	3 (12.0)
Rectal adenocarcinoma	1 (4.0)
Small bowel adenocarcinoma	1 (4.0)
Stoma formation	5 (20.0)
Organs resected	
Omentum	24 (96.0)
Colon	15 (60.0)
Gallbladder	12 (48.0)
Diaphragm (stripping)	12 (48.0)
Ovaries	9 (36.0)
Rectum	8 (32.0)
Small bowel	7 (28.0)
Uterus	7 (28.0)
Spleen	3 (12.0)
Liver	2 (8.0)
Stomach	2 (8.0)
Bladder	1 (4.0)
Pancreas	1 (4.0)
Completeness of cytoreduction score	
CC-0	10 (40.0)
CC-1	14 (56.0)
Number of bowel anastomoses	
1	9 (36.0)
2	9 (36.0)
3	1 (4.0)
Neoadjuvant chemotherapy	
Yes	13 (52.0)
No	12 (48.0)
Adjuvant chemotherapy	
Yes	10 (40.0)
No	15 (60.0)
Clavien–Dindo classification (complications)	
1	14 (56.0)
2	6 (24.0)
3a	4 (16.0)
3b	1 (4.0)
Length of stay, median (range), d	14 (7–69)
Readmission (30 d)	3 (12.0)

CC = complete cytoreduction; CRS = cytoreductive surgery; HIPEC = hyperthermic intraperitoneal chemotherapy; SD = standard deviation.

*Unless indicated otherwise.

Quality of life

The average preoperative global health score was 68.75, which declined significantly 3 months following surgery (57.33, $p = 0.024$), but returned to near baseline levels by

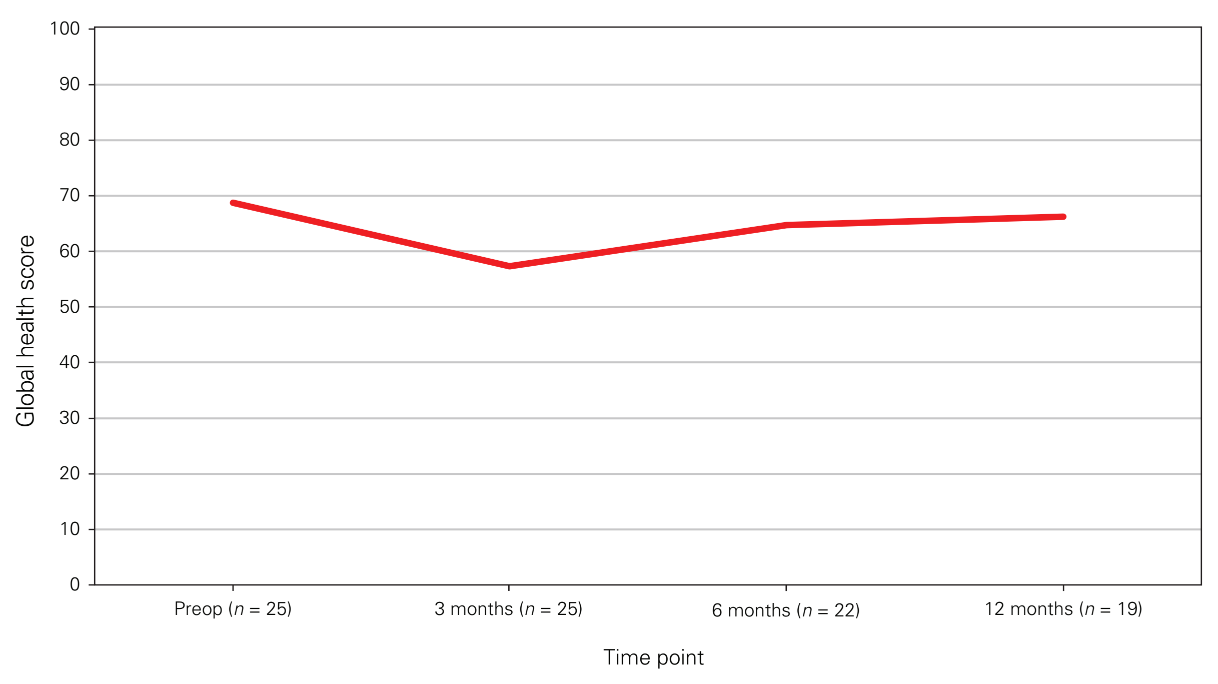

Fig. 1. Global health score of patients undergoing cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy (CRS/HIPEC) at 4 different time points: preoperatively, and at 3, 6, and 12 months following CRS/HIPEC.

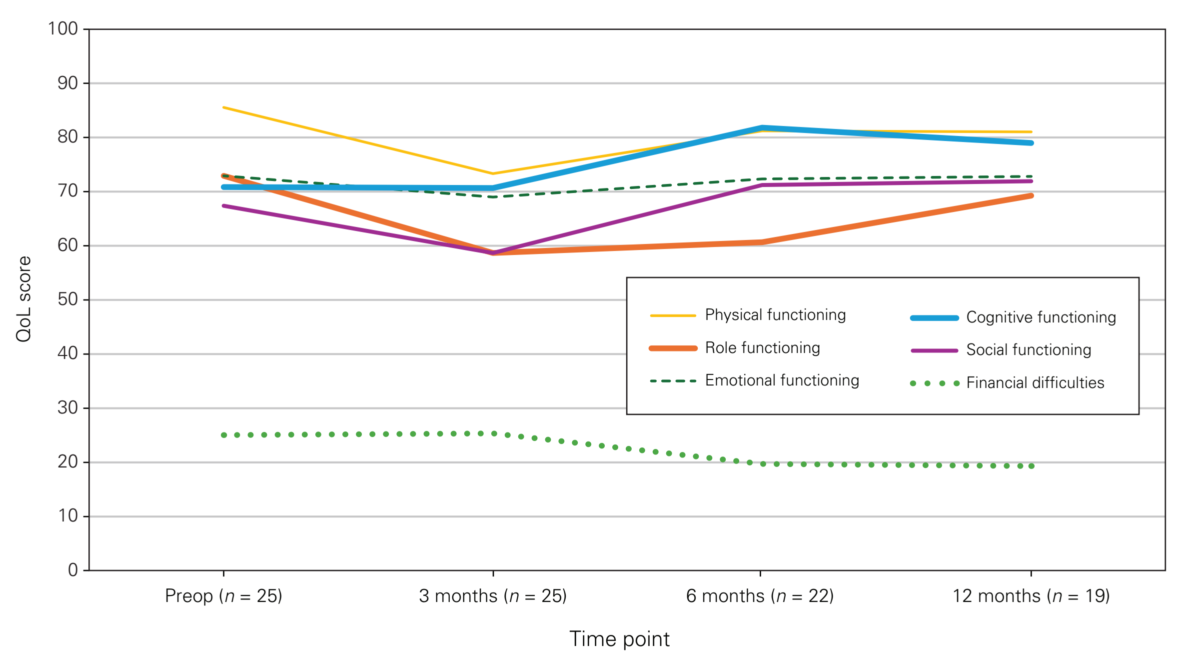

Fig. 2. Quality of life (QoL) scores of patients undergoing cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy (CRS/HIPEC) at 4 different time points: preoperatively, and at 3, 6, and 12 months following CRS/HIPEC.

12 months postoperative (average 66.23, $p = 0.9$), with no statistically significant difference compared with the preoperative score (Figure 1). Similarly, the average physical function score decreased shortly after surgery (85.56 preoperative v. 73.33 at 3 months postoperative, $p = 0.034$), but approached baseline by 6 months postoperative (81.21, $p = 0.116$). Changes in role functioning and emotional functioning followed a similar pattern, with an initial decline at 3 months postoperative, followed by recovery toward baseline by 12 months postoperative, though these changes were not statistically significant. Average cognitive functioning remained stable from preoperative to 3 months postoperative (70.83 v. 70.67, $p = 0.572$), but showed a significant improvement by

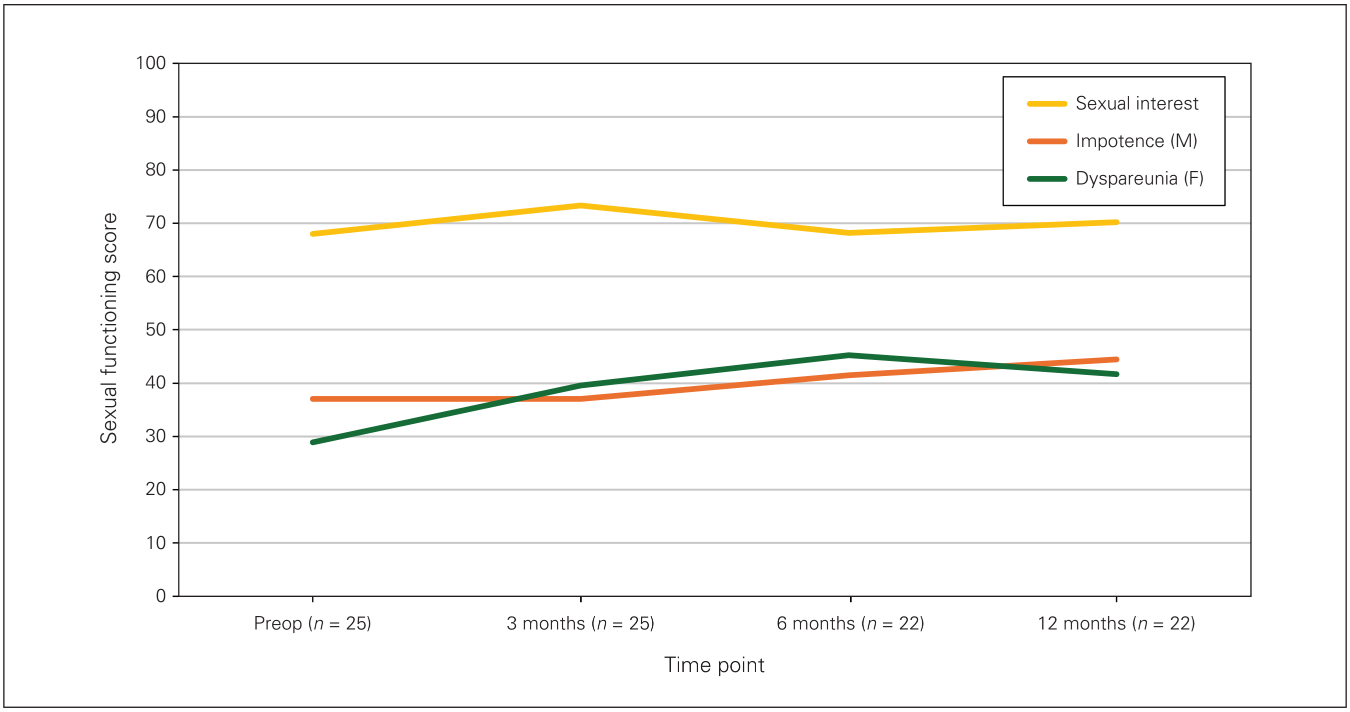

Fig. 3. Sexual functioning scores scores of patients undergoing cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy (CRS/HIPEC) at 4 different time points: preoperatively, and at 3, 6, and 12 months following CRS/HIPEC. F = female; M = male.

Table 2. Descriptive data from the European Organisation for Research and Treatment of Cancer Quality of Life Core 30-item (QLQ-C30) and Colorectal 29-item (QLQ-CR29) questionnaires, *n* = 25

							p value			
Scale	No. of items	Preop *n* = 25	3 mo *n* = 25	6 mo *n* = 22	12 mo *n* = 19	*p* value	Preop to 3 mo	Preop to 6 mo	3 mo to 12 mo	Preop to 12 mo
Global health	2	68.75	57.33	64.77	66.23	0.043	0.024	0.258	0.033	0.900
Physical functioning	5	85.56	73.33	81.21	81.05	0.027	0.034	0.116	0.068	0.346
Role functioning	2	72.92	58.67	60.61	69.30	0.431	0.163	0.388	0.319	0.690
Emotional functioning	4	72.92	69.00	72.35	72.81	0.386	0.148	0.258	0.315	0.660
Cognitive functioning	2	70.83	70.67	81.82	78.95	0.020	0.572	0.017	0.451	0.187
Social functioning	2	67.36	58.67	71.21	71.93	0.340	0.414	0.706	0.132	0.489
Sexual functioning*										
Interest	1	68.00	73.33	68.18	70.18	< 0.001	< 0.001	0.012	1.000	< 0.001
Impotence	1	37.04	37.04	41.67	44.45	0.252	1.000	0.180	0.823	0.314
Dyspareunia	1	28.89	39.58	45.24	41.67	0.472	0.477	0.236	0.813	0.343
Financial difficulties	1	25.00	25.33	19.70	19.30	0.832	0.900	0.753	0.660	0.572

*Average calculated using the QLQ-CR29 score.

6 months postoperative (81.82, $p = 0.017$). Figure 2 shows the changes in functioning scores over time. Average sexual interest scores fluctuated, initially increasing from 68.00 preoperative to 73.33 at 3 months postoperative ($p < 0.001$), followed by a slight decline, but still remained above the baseline score at 12 months postoperative (70.18, $p < 0.001$). Sexual symptom scores (impotence in men, dyspareunia in women) worsened with time, but this difference was not statistically significant. Figure 3 shows the changes in sexual functioning scores over time. Table 2 summarizes the descriptive data from the EORTC QLQ-C30 and QLQ-CR29 questionnaires.

Factors affecting quality of life

On multiple regression analysis, age was significantly associated with a decrease in global function at 6 months ($\beta = -1.07$, $p < 0.05$), while female sex was linked to an improvement in global health at 6 months ($\beta = 16.14$, $p < 0.05$). Worse role functioning at 6 months was observed in patients with a prolonged hospital length of stay (LOS; $\beta = -4.51$), higher postoperative complication rates ($\beta = -9.14$), and those who underwent systemic therapy after surgery ($\beta = -26.66$, $p < 0.05$). However, preoperative systemic therapy was associated with better role

Table 3. Multiple regression analysis showing the β coefficients of QoL at 4 time points

	Global health				Physical functioning				Role functioning				Emotional functioning			
Factor	Preop	3 mo	6 mo	12 mo	Preop	3 mo	6 mo	12 mo	Preop	3 mo	6 mo	12 mo	Preop	3 mo	6 mo	12 mo
Age	0.19	–0.41	–1.07*	–0.32	–0.10	0.20	–0.21	–0.17	0.48	0.47	0.72	–0.85	0.30	–0.48	0.32	–0.34
Sex (ref: Male)	4.93	15.60	16.14*	6.04	–4.26	–0.60	–1.83	–1.11	11.18	3.68	0.13	3.04	8.18	18.05	0.22	7.81
Preop chemo.	–6.55	–1.12	3.64	–10.03	–5.90	7.75	15.79	–1.88	2.28	10.91	28.14*	–6.14	–6.29	6.60	11.42	15.65
PCI	n/a	–0.46	–0.20	–0.34	n/a	0.11	0.34	–0.61	n/a	–0.89	–0.16	–0.11	n/a	–0.94	0.37	–1.40
Stoma	n/a	2.46	8.48	–18.13	n/a	–16.70	0.07	–0.40	n/a	19.04	8.07	–7.25	n/a	16.17	–1.02	24.91
LOS	n/a	0.54	0.98	0.52	n/a	0.45	–0.90	–1.00	n/a	–0.43	–4.51*	–0.27	n/a	0.79	–2.13	–1.25
Clavien–Dindo classification	n/a	–4.76	–7.58	–4.69	n/a	–6.97	0.45	0.28	n/a	–8.72	–9.14*	3.57	n/a	–4.41	4.29	0.41
Adjuvant chemo	n/a	11.89	9.89	–10.14	n/a	2.79	–7.23	–10.16	n/a	3.15	–26.66*	–0.95	n/a	–2.04	–19.81	–27.01
Readmission	n/a	22.44	8.01	31.70	n/a	43.22	–4.20	20.71	n/a	4.79	–68.00	63.62	n/a	15.42	–58.21	–34.87
CC	n/a	–19.73	–14.45	–50.97	n/a	–22.84	17.49	–15.85	n/a	25.96	93.51	–53.00	n/a	2.89	43.77	20.33
Colon resection	n/a	–5.65	1.00	12.20	n/a	–6.72	–2.95	18.68	n/a	–7.97	13.24	7.81	n/a	15.03	3.54	35.63
Recurrence	n/a	8.48	–2.47	–0.31	n/a	–2.30	–0.56	3.59	n/a	2.39	–12.06	11.79	n/a	5.56	–3.71	3.17

CC = complete cytoreduction; LOS = length of stay in hospital; n/a = not applicable; PCI = Peritoneal Carcinomatosis Index; QoL = quality of life.
*$p < 0.05$.

Table 4. Multiple regression analysis showing the β coefficients of QoL at 4 time points

	Cognitive functioning				Social functioning				Sexual functioning				Financial challenges			
Factor	Preop	3 mo	6 mo	12 mo	Preop	3 mo	6 mo	12 mo	Preop	3 mo	6 mo	12 mo	Preop	3 mo	6 mo	12 mo
Age	–0.01	0.28	0.94	–0.42	0.92*	–0.79	–0.58	–1.11	0.87	–2.21*	–1.32	–2.50*	–0.42	0.17	–2.13*	–0.90
Sex (ref: Male)	1.27	5.80	–13.98	6.84	–12.04	15.97	12.19	1.32	6.89	29.24*	7.66	11.17	–16.67	–30.49	–3.16	–4.52
Preop chemo	5.66	–2.77	5.48	–22.95	–5.25	8.56	–32.39*	–1.77	–22.52*	–28.71	–2.30	–39.86	9.76	4.64	–18.84	14.10
PCI	n/a	–1.37*	0.05	–0.18	n/a	–1.23	0.41	–1.18	n/a	–0.41	0.28	–1.06	n/a	–0.84	–0.26	1.48
Stoma	n/a	41.95*	5.64	19.32	n/a	18.22	–5.44	18.16	n/a	3.64	8.07	6.85	n/a	29.47	27.13	30.86*
LOS	n/a	0.78	–4.72	–3.14	n/a	0.89	–1.36	1.66	n/a	1.90	1.19	1.81	n/a	–1.69	3.87	7.02*
Clavien–Dindo classification	n/a	–8.05	6.52	9.81	n/a	–6.19	–0.07	–0.59	n/a	–16.13*	–11.12	–3.30	n/a	8.77	3.35	–15.45
Adjuvant chemo	n/a	8.48	–28.66	–5.06	n/a	23.14	–2.38	16.37	n/a	28.80	21.11	24.74	n/a	–27.32	43.87	26.25
Readmission	n/a	61.77*	–11.01	–86.71	n/a	62.24	–52.03	91.51	n/a	–16.02	–25.43	52.81	n/a	–83.54	79.12	96.91
CC	n/a	–37.83	13.78	83.64	n/a	–7.77	61.00	–9.90	n/a	59.53	39.64	–49.78	n/a	92.30	–70.98	–71.92
Colon resection	n/a	–4.44	–0.36	7.45	n/a	–1.53	7.33	26.55	n/a	–30.29	–17.77	13.20	n/a	18.59	–1.30	–36.30
Recurrence	n/a	5.51	–1.61	–28.92*	n/a	9.93	–11.76	7.70	n/a	18.34	–19.44	13.68	n/a	18.61	15.48	10.74

CC = complete cytoreduction; LOS = length of stay in hospital; n/a = not applicable; PCI = Peritoneal Carcinomatosis Index; QoL = quality of life.
*$p < 0.05$.

functioning at 6 months ($\beta = 28.14$, $p < 0.05$), but poorer social functioning ($\beta = –22.52$, $p < 0.05$) at the same time point. Cancer recurrence was significantly linked to reduced cognitive function at 12 months postoperative ($\beta = –28.92$, $p < 0.05$). On the contrary, patients with a stoma or those readmitted to hospital after discharge showed better cognitive function at 3 months postoperative ($\beta = 41.95$ and $\beta = 61.77$, respectively, $p < 0.05$). Higher intraoperative PCI scores were associated with poorer cognitive function at 3 months postoperative ($\beta = –1.37$, $p < 0.05$). Both age and the severity of postoperative complications were negatively correlated with sexual functioning after surgery, while women exhibited better sexual function at 3 months postoperative ($\beta = 29.24$, $p < 0.05$). Financial difficulties were more pronounced in patients with a stoma and those with extended LOS ($\beta = 30.86$ and $\beta = 7.02$, respectively, $p < 0.05$). None of the analyzed factors or characteristics significantly affected physical or emotional functioning. The results of the multiple regression analysis, including the β coefficients for QoL across

4 time points, are presented in Table 3 and Table 4. Post hoc power analysis was conducted using prior literature to assess the likelihood of detecting a true effect given the observed sample size and effect size.[20,21] The analysis revealed a post hoc power of 63.4%, and this should be considered when interpreting the study findings.

Qualitative assessment of factors affecting quality of life

The response rate to the qualitative questions ranged from 96% to 100% over the 4 time points. During the preoperative assessment, the most commonly reported positive factors were family and social support (n = 11), and maintaining an active lifestyle (n = 8). The most frequently cited negative factors were concerns about the cancer diagnosis and prognosis (n = 10), and adverse effects of chemotherapy (n = 9). At 3 months following CRS/HIPEC, the predominant positive factors were reassurance of cancer treatment success (n = 8), the quality of care provided by the medical team (n = 7), and family and social support (n = 7). Negative factors most frequently reported at 3 months following CRS/HIPEC were postoperative symptoms (n = 9), and continued worries about the cancer diagnosis and prognosis (n = 7). At 6 months following CRS/HIPEC, family and social support (n = 9), and the quality of medical care (n = 5) were the most commonly reported positive factors. Common negative factors were ongoing symptoms (n = 9), concerns about cancer recurrence or prognosis (n = 7), and limitations in physical activity (n = 7). At 12 months postoperatively, family and social support (n = 8), and maintaining an active lifestyle (n = 8) remained the most significant positive influences. Negative factors were persistent concerns about the cancer diagnosis and prognosis (n = 10), physical limitations (n = 5), and chemotherapy-related adverse effects (n = 5). Figure 4 shows the distribution of positive and negative factors reported at each time point.

DISCUSSION

This pilot study evaluates the trends in QoL among patients undergoing CRS/HIPEC at a single tertiary care centre. We found that following an initial decline, global health scores and physical function scores returned to preoperative levels by 6 to 12 months following CRS/HIPEC. Role and emotional function scores showed a similar pattern, though these were not statistically significant. Our findings align with those of previous studies[12,16,19,22] that reported an initial postoperative decline in QoL followed by gradual improvement at up to 1 year,[19,23] with some patients exceeding preoperative baseline scores.[4] Despite the relatively small sample size of this study, which may have affected the statistical power of the findings, our results provide valuable insight into QoL trajectories following CRS/HIPEC. Smaller cohort studies, especially those with longitudinal follow-up that strengthens the validity of the findings, remain important in identifying trends and generating preliminary data.

The trends we observed in this study are consistent with recovery trajectories following other major surgeries, where QoL often decreases at 3 months postoperative owing to ongoing recovery.[12,24] In a large comparative study comparing patients with peritoneal colorectal metastases treated with CRS/HIPEC and those with primary colorectal cancer undergoing standard surgical resection, patient-reported outcomes and QoL measures remained comparable between the 2 groups up to 1 year postoperative, despite the increased procedural complexity and higher morbidity risk associated with CRS/HIPEC.[21] Physical function worsens immediately after surgery, which often reflects the recovery period from surgery and LOS. Pain scores then improve over time, contributing to better functional health after 6 to 12 months.[24] Over time, patients' psychological adaptation to life after surgery may play a role in the recovery of QoL. McQuellon and colleagues reported that 75% to 96% of patients are able to resume normal activities to a reasonable degree within 12 months following CRS/HIPEC.[25] An important consideration is that the preoperative baseline does not represent a truly "premorbid" or healthy state, as many patients with peritoneal carcinomatosis may already be experiencing some decline in quality of life at baseline. However, only a subset of patients are symptomatic at baseline; many remain functionally well and systemically healthy — an essential prerequisite for eligibility for CRS/HIPEC, given its invasiveness. From this perspective, a return to baseline global health and physical functioning scores by 3 months postoperative is both expected and clinically meaningful, reflecting the relatively high baseline physical status required for surgery. Additionally, as shown in Figure 2, cognitive and social functioning improve beyond baseline between 6 and 12 months, likely reflecting recovery from the emotional and psychological distress related to the cancer diagnosis rather than physical impairment alone. Slight improvements in sexual functioning may similarly relate to enhanced emotional and cognitive well-being over time. Among patients in our study, emotional function recovered first, while cognitive function showed a steady postoperative improvement, surpassing baseline levels by 6 months. This steady improvement in cognitive and emotional QoL scores may be explained by 2 phenomena: response shift and posttraumatic growth. Response shift occurs when a patient achieves emotional and cognitive well-being despite physical and functional limitations, likely owing to the reassurance that surgery may provide them a chance at long-term survival.[4,26] Hope among patients with cancer is a complex phenomenon that defies the conventional assumption that a terminal diagnosis inevitably leads to hopelessness. Multiple studies have reported higher-than-anticipated levels of hope in patients

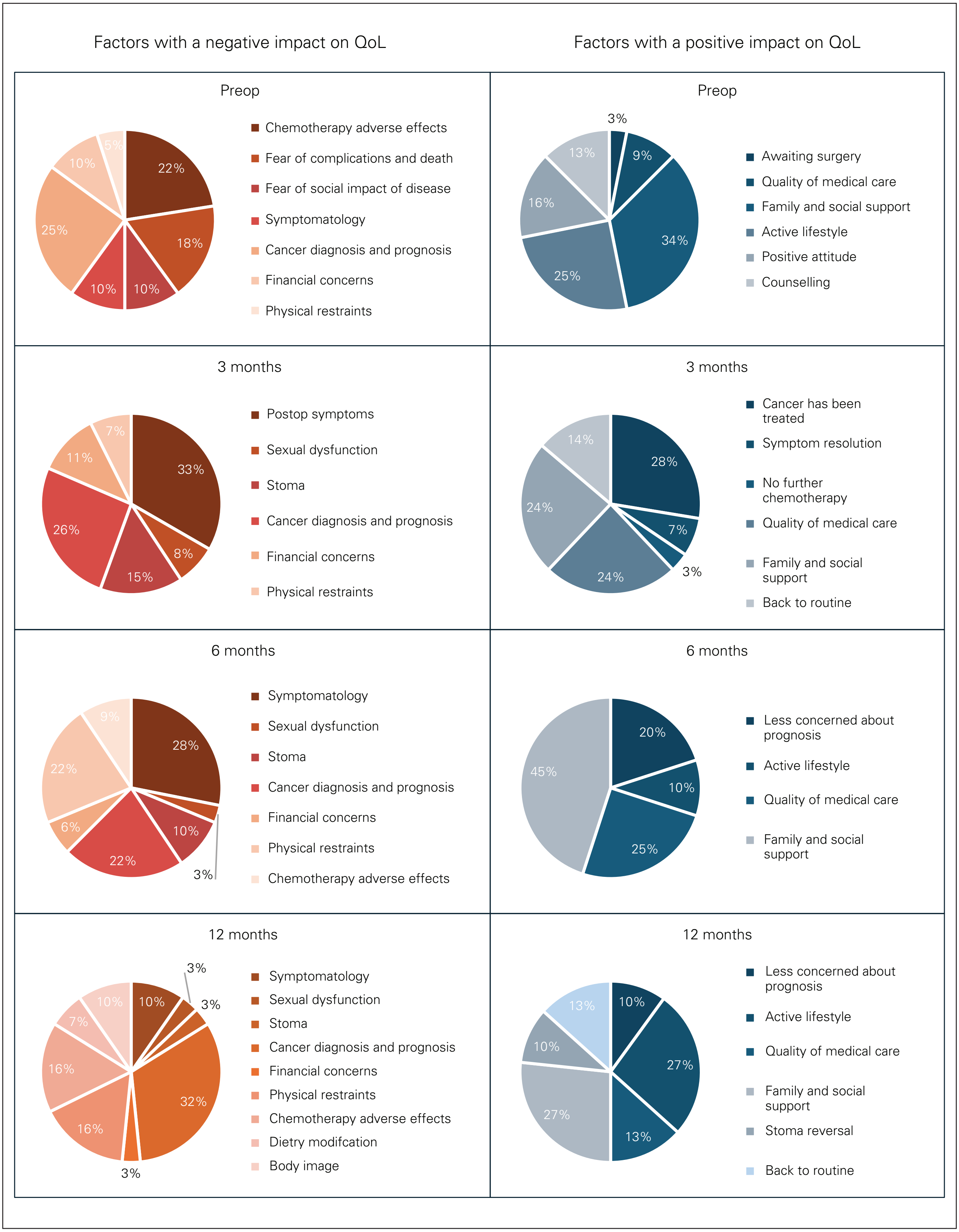

Fig. 4. Qualitative assessment showing patient-reported factors with positive and negative effects on quality of life (QoL).

with advanced disease, which suggest that despite the profound psychological and existential challenges posed by life-limiting illnesses, hope remains a central and enduring aspect of the human experience.[26] In our study, even patients who experienced postoperative complications reported high emotional functioning scores, emphasizing the sense of hope and optimism following treatment regardless of perioperative challenges.[20] Second, posttraumatic growth can occur when a patient has confrontation with mortality from having undergone treatment for a serious diagnosis that then leads to a more positive life philosophy and improved self-esteem.[13,27] This correlates with our qualitatively findings, where the most frequently reported factor with positive impact on QoL at 3 months postoperative was the reassurance that their cancer had been treated.

Postoperative sexual health is a complex issue, further complicated by the psychosocial impact of cancer on sexual well-being, which can be both multifaceted and prolonged.[22] Additionally, long-term follow-up suggests that reduced sexual function often persists below baseline levels and affects both men and women.[12] In our study, sexual interest scores initially improved by 3 months following CRS/HIPEC, but then fluctuated, ultimately showing an improvement from baseline by the 12 month time point. However, sexual symptom scores, including impotence in men and dyspareunia in women, worsened. Factors associated with worse sexual function included advanced age (preoperative sexual function), high-grade postoperative complications, and male gender. Zenasni and colleagues found that sexual dysfunction often persisted as a long-term issue after CRS/HIPEC.[28] Their study highlighted that female patients undergoing pelvic surgery were particularly affected, reporting reduced libido, decreased interest in sexual activity, and early menopause because of treatment.[28] An important contributing factor in this population is the development of low anterior resection (LAR) syndrome, which has been shown to negatively affect sexual QoL.[29] Patients with LAR syndrome frequently report higher levels of embarrassment, altered body image, and increased sexual anxiety and impotence.[29] This highlights the importance of screening for these symptoms during follow-up, providing appropriate treatment, and referring patients to relevant specialists when necessary to enhance their long-term QoL.

We sought to evaluate clinical factors influencing QoL and to stratify patients' baseline characteristics in relation to QoL measures, which can inform surgical planning and preoperative discussions with patients. Leimkühler and colleagues conducted a systematic review indicating that QoL is negatively affected by several factors, including older age, female sex, prolonged operation time, extensive disease, residual disease, adjuvant chemotherapy, postoperative complications, stoma placement, and disease recurrence.[19] Consistent with these findings, we identified increasing age as being associated with worse global function and heightened financial challenges following CRS/HIPEC. While age is often less significant than functional status, returning to baseline physical function and resuming normal work activities could become more challenging as age increases. In contrast, female sex emerged as a protective factor in our cohort, with women reporting better global health and sexual function 6 months following CRS/HIPEC. Preoperative systemic therapy also correlated with improved postoperative role function and social function, likely explained by cessation of chemotherapy-related adverse effects, if chemotherapy was discontinued in the postoperative setting.[30] As expected, adjuvant systemic therapy was associated with poorer role functioning at 6 months following CRS/HIPEC. Disease burden, as measured by the PCI, has been associated with worse QoL outcomes in previous studies.[4,19] However, in our study, while a higher PCI was linked to worse cognitive function at 3 months, it was not significantly associated with other QoL measures. This finding may be attributed to the heterogeneity of disease extent among patients undergoing CRS/HIPEC, as reflected in the wide PCI range within our cohort (0 to 39) and the variability in organ resections performed. Additionally, the relatively small sample size may have limited the ability to detect significant differences across other QoL domains, as observed in prior studies. Prolonged hospital LOS and higher complication grades were linked to worse role functioning and greater financial challenges following CRS/HIPEC. One approach to mitigate these issues could involve the adoption of Enhanced Recovery After Surgery (ERAS) protocols. A recent study from our institution reported that implementing a patient-focused ERAS CRS/HIPEC program led to significant reductions in LOS,[31] which could improve QoL, particularly in the early postoperative period. While major complications are frequent after CRS/HIPEC and may impact QoL in the immediate postoperative phase, studies show that QoL scores at 6 months are similar among patients regardless of having had complications.[20] Interestingly, both hospital readmission and stoma formation were associated with improved cognitive function at 3 months following CRS/HIPEC in our cohort. Although this finding was unexpected, it may suggest that patients felt a sense of relief from having their disease managed by the care team during readmission or through stoma placement, which allowed them to focus on physical recovery. This may also reflect the high quality of care provided, as cognitive QoL scores were less affected by readmissions owing to the supportive environment. Many patients in our study considered the quality of care to be a positive factor during their recovery following CRS/HIPEC. However, other studies have reported worsened social function with stoma formation, possibly owing to reduced social interactions following changes in body image and low self-esteem.[22,29]

Disease recurrence remains another key factor influencing QoL, as oncological outcomes can significantly affect overall well-being following CRS/HIPEC.[12,20] In our study, disease recurrence was linked to poorer cognitive function at 12 months, a period often coinciding with recurrence.[32] Dodson and colleagues showed that in patients with long-term survival, some QoL improvements observed between 6 and 12 months deteriorated owing to disease recurrence,[15] whereas Hinkle and colleagues reported that the expected QoL improvements following CRS/HIPEC were never fully met in patients who experienced recurrence.[23]

Limitations

Our study is unique as it assessed the QoL outcomes of CRS/HIPEC both subjectively and objectively, with the aim of gaining a deeper understanding of the factors that are important to patients and their overall experience. However, several limitations should be noted. First, our patient cohort was heterogeneous, encompassing various pathologies, natural histories, and prognostic outcomes. While this diversity may limit the generalizability of findings to specific groups, it is also a strength, as studies examining a heterogeneous group are valuable in evaluating the procedure as a whole and allow for the inclusion of a broader patient population. Second, the response rate to participate in the study was 24.3%, which may not fully represent all patient experiences. This low participation rate was due to several factors, including limited research resources; the COVID-19 pandemic and its effect on in-person clinical encounters; and the temporary shift to virtual care, which restricted opportunities for consent and data collection. In addition, our centre receives referrals from out-of-province patients, many of whom undergo their initial workup and follow-up locally, making it challenging to include them in longitudinal research. Operational constraints, such as scheduling conflicts, incomplete consent, and staffing limitations, also contributed. Furthermore, questionnaires were available only in English, which led some non-English-speaking patients to decline participation. A few patients also withdrew consent after CRS/HIPEC was not completed and their care transitioned to palliative services outside of the surgical team's follow-up. Third, our assessment was confined to a 12-month period, although fluctuations in QoL scores may continue beyond this time frame.[15] This highlights the need for ongoing psychological support at least for the first year after surgery, and potentially for a longer duration. Another limitation is that our analysis did not include a control group, which limits comparability and introduces selection bias. Moreover, our baseline (preoperative) QoL scores were obtained during a time when patients may have already been experiencing clinical symptoms related to their disease. As a result, their QoL may have already been compromised compared with their QoL before disease onset. This aspect is important for understanding patient expectations and perspectives regarding QoL improvements after surgery. Finally, both the EORTC QLQ-C30 and QLQ-CR29 questionnaires are not specifically tailored for CRS/HIPEC patients. Therefore, future research should focus on developing and validating questionnaires that are specific to CRS/HIPEC, enabling a more precise assessment of QoL domains relevant to this particular patient population, and include long-term survivors to better capture a return to baseline functioning unrelated to malignancy.

CONCLUSION

The results of our study show that while patients experience a significant decline in global health and physical function shortly after CRS/HIPEC surgery, these measures largely return to baseline levels by 12 months postoperative. Family and social support were consistently identified as key positive factors influencing QoL, while concerns about cancer prognosis and chemotherapy adverse effects were identified as negative factors throughout the study period. We also highlight the influence of specific factors, including age, gender, complications, and systemic therapies, on patients' recovery trajectories across various domains of QoL. This study is unique in its comprehensive evaluation of QoL trajectories following CRS/HIPEC by incorporating both quantitative and qualitative patient-reported outcomes. Unlike previous studies that primarily focused on objective clinical measures, our research captures patient perspectives through validated QoL instruments and open-ended responses, offering deeper insight into the lived experience of recovery. Our findings underline the importance of long-term comprehensive patient support and targeted interventions to address the evolving needs of patients following CRS/HIPEC.

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