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Palliative Surgery for Malignant Bowel Obstruction from Carcinomatosis: A Systematic Review

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Abstract

Importance—Care of patients with malignant bowel obstruction caused by peritoneal metastases may present an ethical dilemma for surgeons when nonoperative management fails.

Objective—To characterize outcomes of palliative surgery for malignant bowel obstruction from peritoneal carcinomatosis to guide decision making about surgery and postoperative interventions for patients with terminal illness.

Evidence Review—We searched PubMed, EMBASE, Cochrane Library, Web of Knowledge, CINAHL Plus, and Google Scholar, and performed manual searches of selected journals from inception to August 30, 2012 with no filters, limits, or language restrictions. We used database-specific combinations of *intestinal obstruction*, *malignant*, *surgery* or *surgical*, and *palliat**. We included studies reporting outcomes after palliative surgery for malignant bowel obstruction from peritoneal carcinomatosis from any primary malignancy and excluded case studies, curative surgery, isolated percutaneous procedures, stenting for intraluminal lesions, and studies in which

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Terrah Paul Olson, Carolyn Pinkerton, Karen Brasel, and Margaret Schwarze have no conflicts of interest or relevant financial interests, activities, relationships, or affiliations to disclose.

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Supplementary information on the individual search strategies by database is included in an online-only table (eTable 1).

Author contributions:
Study conception and design: Terrah Paul Olson, Karen Brasel, Margaret Schwarze
Acquisition of data: Terrah Paul Olson, Carolyn Pinkerton
Analysis and interpretation of data: Terrah Paul Olson, Carolyn Pinkerton, Margaret Schwarze
Drafting of manuscript: Terrah Paul Olson, Margaret Schwarze
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Statistical analysis: Terrah Paul Olson
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Terrah Paul Olson and Margaret Schwarze had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

benign and malignant obstructions could not be distinguished. We assessed quality with the Newcastle-Ottawa Scale.

Findings—We screened 2347 unique articles, selected 108 articles for full-text review, and included 17 studies. Surgery was able to palliate obstructive symptoms for 32 to 100% of patients, enable resumption of a diet for 45 to 75% of patients, and facilitate discharge to home in 34–87% of patients. Mortality was high (6–32%), and serious complications are common (7–44%). Frequent re-obstructions (6–47%), readmissions (38–74%), and re-operations (2–15%) occur. Survival was limited (median 26–237 days), and hospitalization for surgery consumed a substantial portion of the patient's remaining life (11–61%).

Conclusions and Relevance—Although palliative surgery can benefit patients, it comes at the cost of high mortality and substantial hospitalization relative to the patient's remaining survival time. Preoperatively, surgeons should present realistic goals and limitations of surgery. For patients choosing surgery, clarifying preferences for aggressive postoperative interventions preoperatively is critical given the high complication rate and limited survival after surgery for malignant bowel obstruction.

Introduction

Malignant bowel obstruction (MBO) is a common pre-terminal event for patients with advanced cancer, with an incidence as high as 28% in gastrointestinal cancer and 51% in ovarian cancer[1,2]. Patients with MBO are unable to eat, experience severe pain, and develop intractable nausea and vomiting – symptoms that incite considerable distress for patients and their families[3,4]. Treatment options include supportive care with nasogastric drainage, pain control, antiemetics, antisecretory medications, and corticosteroids; endoscopically placed stents; percutaneous endoscopic gastrostomy tubes; or palliative surgery to relieve symptoms[5]. Palliative operations can be successful for patients with MBO from intraluminal or localized tumors, but are less effective for patients with MBO from carcinomatosis[5–7]. However, patients with MBO from peritoneal metastases can develop distressing symptoms despite maximal medical treatment and present the surgeon with an ethical dilemma.

Surgical decision making in this setting is particularly difficult; an operation may provide relief of intolerable symptoms for a patient, but patients with MBO due to peritoneal metastases may have only weeks or months to live[2,8] and are often poor surgical candidates because of malnutrition and underlying disease[5,6]. Patients with terminal illness may prefer to avoid burdensome treatments near the end of life[9–11]. Additionally, frail patients may agree to an initial operation to alleviate severe symptoms, but then choose to forgo aggressive treatments in the postoperative period[12]. Surgical decision making for MBO is further complicated by a lack of high quality data. Information regarding palliative outcomes including quality of life, functional outcomes, or patient distress is sparse.

We performed a systematic review of the literature to determine the effects of palliative surgery for MBO associated with peritoneal metastases on quality of life, successful palliation, postoperative mortality, complications, and survival to help surgeons and patients make decisions about surgery that are in line with the patient's goals and values. This information may have particular value for surgeons and for patients who choose to have

surgery, as it can facilitate preoperative discussion about the patient preferences for aggressive postoperative treatments.

Methods

We performed a systematic review according to guidelines outlined in the Cochrane Collaboration Handbook[13]. Before starting our literature search and data collection, we designed a protocol based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses statement[14] and Meta-analysis of Observational Studies in Epidemiology guideline[15].

Data Sources and Search Strategy

We searched PubMed, EMBASE, the Cochrane Library, Web of Knowledge, Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus, and Google Scholar from inception to August 30, 2012. We used database-specific combinations of the following index terms and text words: *intestinal obstruction*, *malignant*, *surgery* or *surgical*, and *palliat**. To avoid studies focused on endoscopic stenting of obstructive intraluminal lesions, we designed our search to omit articles with the terms "*stent*" or "*stenting*" in the title. We used an English-only filter for our search of Google Scholar to obtain a manageable collection of results, but we did not use any filters or limits for the remaining databases. Details of the search strategy for each database are described in the Supplement (eTable). In addition, we performed a hand search of the tables of contents of *Annals of Surgical Oncology*, *Palliative Medicine*, *Journal of Pain and Symptom Management*, and *Gynecologic Oncology* from inception of each journal through August 30, 2012. These searches were supplemented with manual review of references from review articles retrieved from the primary database search. We used EndNote X5 and EndNote Web (Thomson Reuters, New York, NY) to organize references.

Inclusion and Exclusion Criteria

According to our protocol, we included original research describing outcomes of open or laparoscopic surgery for bowel obstruction from peritoneal carcinomatosis while excluding treatment of intraluminal lesions. Outcomes of interest included survival, postoperative mortality, postoperative complications (specifically rates of wound infection, wound dehiscence, enterocutaneous fistula, anastomotic leak, deep vein thrombosis/pulmonary embolus, bleeding complications, gastrointestinal bleeding, myocardial infarction, sepsis, or other complications), hospital length of stay, intensive care unit length of stay, postoperative use of life supporting interventions such as mechanical ventilation or cardiopulmonary resuscitation, additional procedures or operations, conversations about goals of care, pain control, control of nausea and vomiting, ability to tolerate a diet, freedom from nasogastric tube drainage, discharge disposition including hospice, incidence of re-obstruction, and patient-reported quality of life measures using validated instruments.

We excluded articles that did not report baseline characteristics of the study group, studies that did not separate surgical outcomes for benign obstructions from those for malignant obstructions, reports including operations with curative rather than palliative intent, series

that reported only obstructions amenable to stenting (i.e. large bowel or gastroduodenal obstructions) or reported only percutaneous procedures, and case studies that included fewer than five patients. We also excluded reviews, editorials, conference proceedings, and articles that were not peer reviewed.

Study Selection and Data Extraction

One reviewer (TJPO) evaluated titles and abstracts of all identified articles to develop a subset for full-text review. We obtained translations of articles in French and Chinese which were identified by their abstracts in English as potentially relevant for full text review. Two independent reviewers (TJPO and CP) applied the inclusion and exclusion criteria from our protocol to the full-text articles to identify articles for review. We adjudicated discrepancies between the reviewers' assessments through collaborative discussion. Because included studies covered a broad time-span, we did not contact study authors to obtain additional data. One reviewer (TJPO) extracted data from included studies according to the criteria defined in the protocol.

Data Synthesis

Fifteen of 17 studies included in this review were of low methodological quality with significant risk of bias and heterogeneity. As such, we were unable to perform statistical meta-analysis on the extracted data. Instead, we performed descriptive synthesis of the outcomes reported for studies that met our inclusion criteria.

Quality Assessment

We used the Newcastle-Ottawa Scale for cohort studies[16] to assess the quality of studies included in this review. None to nine stars are awarded for the methodological quality of case selection, comparability of cohorts, and measurement of outcomes. Six or more stars are considered high methodological quality[16,17]. We also assessed confounding factors and risks of bias that were not addressed by study design or data analysis using the Cochrane Collaboration Handbook classification of bias[13].

Results

We identified 3115 articles through database retrieval and located an additional 33 titles by hand for a total of 3148 articles. Of these, 801 were duplicates, leaving 2347 unique articles. After screening titles and abstracts, we excluded 2239 articles that did not fit our inclusion criteria. We reviewed the full text versions of the remaining 108 articles and excluded an additional 90 articles. Two articles reported the results of a single study, so we extracted data from these articles as if they were one study. Our final cohort contained 18 articles describing 17 studies (Figure).

Study and Patient Characteristics

We found 17 studies published between 1982 and 2012[18–35], including 11 retrospective single-institution case series[18–20,22–26,30,31,34,35], three retrospective single-institution cohort studies[21,28,29], two retrospective multi-center cohort studies[27,32], and one prospective single institution cohort study[33] (Table 1). Of the six cohort studies, one compared two

distinct operative interventions (exploratory laparotomy alone compared with major intestinal surgery)[28], three compared surgical patients to patients managed by gastric drainage[21,27,29], one compared surgical patients to patients treated with octreotide[32], and one compared surgical patients to patients managed with either percutaneous endoscopic gastrostomy (PEG) tubes or colonic stents for extrinsic intestinal obstruction from intra-abdominal tumor[33].

The 17 studies included a total of 868 patients, of whom 77% were female. Median reported age was 52 to 63 years (range 19 – 90). Several types of surgical interventions were performed, including creation of an ostomy (colostomy, ileostomy, or jejunostomy), intestinal resection and/or bypass (enteroenterostomy, enterocolostomy, or colocolostomy), lysis of malignant adhesions, open or percutaneous placement of gastrostomy tube or long jejunal tube, and exploratory laparotomy without additional intervention for cases where carcinomatosis was too extensive. No study used a pre-specified protocol for operative intervention; the operations performed were determined by intra-operative findings[18–35].

Patients had a variety of primary malignancies including colorectal, gastric, gynecologic (ovarian, cervical, uterine, endometrial, and unspecified gynecological malignancies), melanoma, breast, pancreaticobiliary, gallbladder, small bowel, gastrointestinal stromal tumor, kidney, bladder, lung, prostate, esophageal, duodenal, periampullary, carcinoid, adrenal, extremity sarcoma, other non-gynecologic visceral malignancies, tumors of unknown gastrointestinal origin, and unknown primary malignant neoplasms. Ten studies described only patients with ovarian cancer[26–35].

Outcomes of Palliative Surgery

Studies demonstrated benefits from palliative surgery for MBO, including relief of obstructive symptoms, ability to tolerate a diet, and discharge to home. Obstructive symptoms were relieved or diet was resumed after surgery in 32–100% of patients[18–21,27,30,32,33]. Patients were able to tolerate a diet postoperatively in 45–75% of cases[18,19,22,23,28,29,31,32,34,35], and 34–87% of patients were discharged to home[20,21,23,28,30]. Other measures of palliation such as validated quality of life metrics or measures of patient distress, were not reported by any studies. Furthermore, markers of quality end-of-life care such as goals-of-care meetings or discussions of do-not-resuscitate status were not reported in any studies.

Thirty-day postoperative mortality was high, with rates ranging from 6–32%[18–20,22,24–32,35]. The incidence of serious complications was 7–44%. These complications included enterocutaneous fistula, wound infection, wound dehiscence, early obstruction, high output ostomy, myocardial infarction/cardiovascular failure, deep vein thrombosis/pulmonary embolus, pulmonary infection/pneumonia, anastomotic leak, and infection[18–20,22,24–29,31–35].

Re-obstruction occurred in 6–47% of patients[19–21,27,29–31,33,35], and the duration of symptom relief after palliative surgery was short, with only 32–71% of patients remaining symptom-free or tolerating a diet 60 days postoperatively[27,29–31,33–35]. One study reported a 74% all-cause readmission rate[22], and others reported readmission rates of 38–47% for

recurrent bowel obstruction[19,20]. Few patients (2–15%) underwent additional operations to address complications or re-obstruction[19,20,28,29,31,35]. However, one study[19] reported that only 46% of patients with repeat surgery were able to return home postoperatively, and complications and mortality were frequent in this group (46% and 23%, respectively).

Median survival time after diagnosis of MBO was 26–273 days[19–27,29–31,33,35] and was related to prognostic features. Two studies compared survival for patients with favorable indicators (no ascites or palpable masses, return of bowel function postoperatively) to patients with poor prognostic features (ascites, palpable masses, or continued obstruction postoperatively). Median survival was 154–192 days with favorable prognostic features, whereas patients with poor prognostic features survived only 26–36 days[20,21].

Mean hospital length of stay (LOS) for initial treatment of MBO, including a preoperative trial of conservative management, was 12.5–31 days and ranged from 1–94 days[19,21,29,31,33]. Time spent in the hospital relative to remaining life was considerable. Two studies[19,29] reported that approximately one-fourth (22–26%) of the patient's remaining life was spent in the hospital, and another reported 11%[31]. For the patients with poor prognostic features (ascites and/or palpable masses) reported by van Ooijen and colleagues[21], 61% of the patients' remaining life was spent in the hospital. Patients who were readmitted also spent significant time in the hospital, with median ranging from 22–41 days[19,22].

Comparative Studies

Five studies compared outcomes between palliative surgery and non-surgical treatments for MBO[21,27,29,32,33] (Table 2). Non-operative alternatives included gastrostomy tube (either open or percutaneous)[21,33], endoscopically-placed intraluminal stents for *extrinsic* compression of the bowel from intra-abdominal metastases[33], nasogastric drainage[27,29], and octreotide[32]. In four of five studies[27,29,32,33], surgery more effectively relieved obstructive symptoms or enabled patients to tolerate a diet, with rates of palliation ranging from 32–100% in the surgical group and 0–75% in the groups with non-operative treatment. Van Ooijen et al[21] compared three groups: surgical patients with favorable prognostic features (no ascites or palpable masses), surgical patients with poor prognostic features (ascites and/or palpable masses), and patients with poor prognostic features who were not operative candidates and were treated with gastrostomy tube alone. They found high rates of palliation in patients with favorable prognostic features who had surgery and in patients with poor prognostic features treated with gastrostomy tubes (85% and 90%, respectively). However, only 43 % of patients with poor prognostic features who were treated with surgery achieved palliation.

Four of five studies reported improved survival with surgery compared with non-operative treatment[21,29,32,33]. Median survival after surgery ranged from 109–191 days versus 33–78 days for non-operative treatments[21,29,33]. Van Ooijen et al[21] reported that patients with poor prognostic features who underwent surgery had a median survival comparable to that of patients with similar features who received only gastrostomy tubes(36 and 33 days, respectively). In contrast, surgical patients with favorable prognostic features had a median survival of 154 days.

Quality of Included Studies and Risk of Bias

The methodological quality of the included studies is summarized in Table 3. Twelve studies[18–26,30,31,34,35] received two to three stars, indicating low methodological quality, and five studies[27–29,32,33] received five to six stars, indicating moderate to high methodological quality.

We identified multiple sources of bias. Selection bias, in which the baseline characteristics of groups are systematically different, was common. Most studies did not report or define the selection strategy for surgical intervention. Five studies[20,27,29,31,32] described criteria for surgery and selected healthier patients for operative intervention. Additionally, three studies[19,20,35] included a mix of patients who had urgent or elective surgery for MBO, but two of these studies[19,20] did not adjust for this significant covariate[36–39].

Patients received treatment with several oncologic interventions before and after treatment of MBO, introducing a risk of performance bias. Additionally, six of 15[21,22,26,32,34,35] studies did not report length of follow up, had very short follow up, or lost a high percentage of patients to follow up, raising the concern for attrition bias. Finally, considerable variation in the reported outcomes (a source of detection bias) complicates comparison of the impact of surgery between studies.

Discussion

Palliative surgery for MBO from peritoneal carcinomatosis can provide relief from obstructive symptoms and enable patients to resume eating as well as return home. However, these benefits come at a cost; mortality and complication rates are high, and re-obstruction requiring readmission and additional procedures is common. Survival is short, and a substantial proportion of the patient's remaining life may be spent in the hospital recovering from surgery and associated complications. This information can help surgeons and patients navigate the preference-sensitive and value-laden decisions surrounding palliative surgery.

For surgeons, these data can be used to facilitate frank discussion about whether palliative surgery is in line with patient preferences and goals of care. First, surgeons can inform patients about the probability of real symptomatic relief with surgery for at least a short time. However, these potential benefits should be presented along with the high probability of serious complications including the high rate of re-obstruction and the substantial duration of hospitalization associated with surgery. Additionally, although palliation might be achieved for a short time, the effects of surgery on quality of life are not well understood[40–44]. Second, surgeons routinely treat postoperative complications aggressively with burdensome treatments[12,45–47] that patients with terminal illness are unlikely to want[9–11]. Because surgery for MBO has substantial morbidity, surgeons should preoperatively explore patients' preferences for limiting aggressive treatments in the event of a postoperative complication. Surgeons often struggle when shifting focus from cure to comfort postoperatively[47–49], but in the setting of palliative surgery, comfort is the primary goal. As such, preoperative clarification of desired "rescue" interventions can be used to

inform difficult treatment decisions for patients, families, and surgeons if complications occur.

For patients, these data illustrate what palliative surgery can realistically accomplish in the setting of MBO. Surgery entails substantial risks for short-lived benefits, and survival is limited. Patients with incurable cancer often hope for considerable benefit and even cure from palliative interventions[50–52]. Data on the likelihood of such benefits can direct patients to anticipate more realistic postoperative outcomes. Patients also should be informed that, although palliative surgery can provide symptomatic relief, this benefit comes at the cost of spending a substantial proportion of their remaining life in the hospital recovering from surgery, even if the postoperative course is uncomplicated. As such, surgery may conflict with the patient's goal of spending as much of his/her remaining life as possible at home with loved ones[53].

For policy-makers, palliative operations contribute to a high proportion of overall mortality[54–56], and as such, a metric that values the use of palliative surgery without penalizing surgeons for associated mortality is required. With increasing focus on outcomes profiling, surgeons and institutions risk penalties for their mortality rates which can be impacted by palliative operations. For example, at Memorial Sloan Kettering Cancer Center, palliative operations (6% of total cases) represent 36% of the institution's 30-day operative mortality[55]. Quality assessment programs, such as the American College of Surgeons' National Surgical Quality Improvement Program, adjust for underlying patient comorbidity but do not have strategies to identify operations performed with palliative intent or capture the palliative benefits offered by surgery aimed at comfort care. Identification of palliative operations and application of standard quality metrics for palliative care is needed to ensure that patients receive the care they desire and avoid aggressive postoperative interventions that conflict with their goals[44,57–59]. Informed patients should be able to choose palliative surgery to control intolerable symptoms, but they should not be subjected to undesired postoperative treatments. This should not be scored as a failure to attempt rescue[12], but rather as a success in eliciting and honoring patient preferences for end-of-life care.

Our study has some limitations. The patients included in this review received treatment between 1977 and 2008. Significant changes in cancer treatment and palliative care occurred over this span of 31 years, including the evolution of effective medical management for MBO in 1985[60]. In addition, patients described in these studies had a mix of primary malignancies. Different cancers have divergent behavior and variable response to treatment that can impact outcomes such as survival and rates of re-obstruction. However, all patients included in the present review had reached the common end point of MBO from peritoneal involvement and underwent palliative intervention. Additionally, it may not be possible to determine with certainty the cause of a bowel obstruction in patients with advanced cancer, particularly if they have had prior operations. This uncertainty can limit the usefulness of these data for a particular patient. This review is also limited by the poor reporting of palliative outcomes after surgery. Quality of life assessments after palliative surgery were rarely initiated, and studies that included quality of life measures were limited by a lack of pertinent assessment tools[41,42]. Research to adapt metrics of palliative care quality[61] and

quality of life assessment[57] for surgical patients is needed to inform surgical decision making and surgical treatment for patients with terminal illness.

The information presented in this review can help surgeons and patients with difficult decisions for patients with terminal cancer. Palliative surgery for MBO can provide benefits, but patients risk serious complications, high rates of re-obstruction, and long hospitalizations. Surgeons can use these data to guide decisions about the role of surgery in the setting of incurable cancer and to advance preoperative discussions by determining patient preferences about burdensome postoperative treatments with unclear benefits. Palliative surgery can be valuable to patients; however, surgeons who provide this treatment should not be penalized for providing comfort for the terminally ill.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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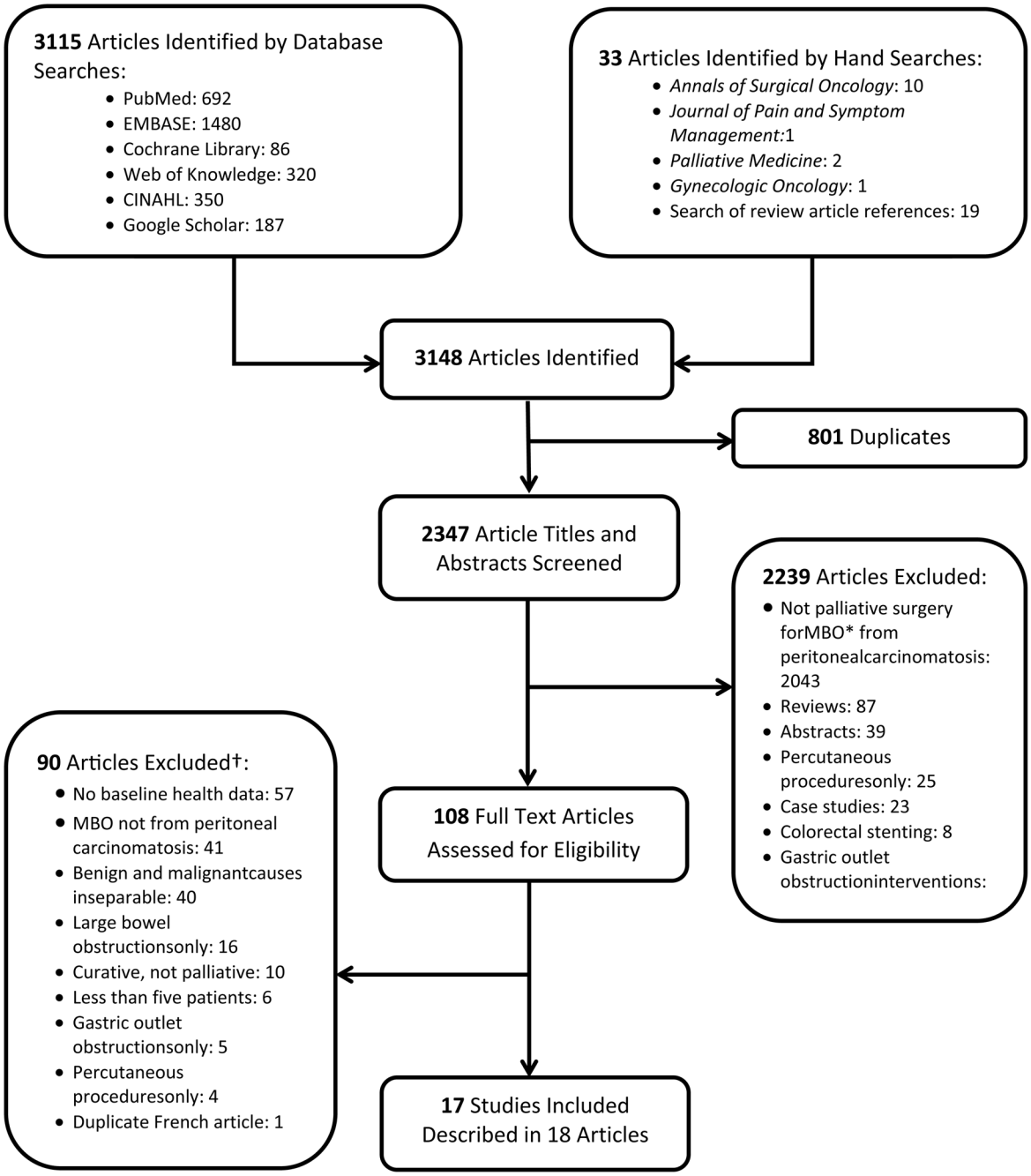

Figure 1.
Flowchart of literature search strategy.

Table 1

Outcomes after palliative surgery for malignant bowel obstruction from peritoneal carcinomatosis.

Study Name	N	% Female	Median Age Years (Range)	Primary Cancer	Palliative Outcomes	Post-operative Mortality	Post-operative Complications	Adverse Outcomes	Survival in Days Median [Mean] (Range)	Length of Stay in Days Median [Mean] (Range)
McCarthy 1986[18] (United States)	12	83	NR	Ovarian:7 CRC[a]: 2 GI[b]: 3	Diet 75% (9/12)	25% (3/12)	25% (3/12) Wound[c]: 3	NR[d]	NR [NR] (3–1080)	NR
Turnbull 1989[19] (United States)	89	39	53 (19–90)	CRC: 59 GI: 25 HPB[e]: 6	Symptoms relieved/ Diet 74% (66/89)	13% (12/89)	44% (38/89) Wound: 6 Bowel[f]: 7 Infectious[g]: 1 Systemic[h]: 1[i]	Re-obstruction with readmission 38% (25/66) Operations 15% (13/89)	98 [135] (1–913)	25 [31] (5–94)
Lau 1993[20] (Hong Kong)	30	43	63[j] (23–84)	CRC: 30	Symptoms relieved 63% (19/30) Home 57% (17/30)	17% (5/30)	27% (8/30) Wound: 2 Bowel: 1 Infectious: 3 Systemic: 2	Re-obstruction with readmission 47% (8/17) Operation 13% (4/30)	*Grp 1*[k] 192 [210] (24–452) *Grp 2*[l] 26 [28] (15–52)	NR
Van Ooijen 1993[21] (the Netherlands)[m]	59	93	*Grp 1*[n]: 55.7[j] (26–72) *Grp 2*[o]: 53.2[j] (26–72)	GYN[p]: 46 CRC: 8 HPB: 1 Other[q]: 2	Symptoms relieved 76% (41/54) Home 34% (20/59)	NR	NR	Re-obstruction 15% (7/46)	*Grp 1*[r] 154 [366[s]] (29–1086) *Grp 2* 36 [58[s]] (3–151)	*Grp 2* 22 [25[s]] (3–53)
Blair 2001[22] (United States)	63	40	58 (25–83)	CRC: 31 GI: 13 HPB: 5 Other: 14	Diet 45% (29/63)	21% (13/63)	44% (28/63) Infectious: 15 Non-infectious: 13	Readmission 74% (39/53)	Actuarial mean: 90	NR
Legendre 2001[23] (Belgium)	109[t]	72[t]	62[t] (32–88)	GYN: 37 CRC: 34 GI: 12 Other: 26	Home with diet 61% (45/73)[u]	NR[u]	NR[u]	NR[u]	58 [NR] (NR)[u]	NR[u]
Abbas 2006[24,] 2007[25] (New Zealand)	79	57	62 (19–91)	CRC: 31 GYN: 19 GI: 3 Other: 25	NR	10% (8/79)	35% (28/79)	NR	150 [NR] (NR)	NR
Piver 1982[26] (United States)	60	100	52 (31–81)	Ovarian: 60	NR	17% (10/60)	31% (19/60) Bowel: 9 Infectious: 2 Systemic: 3 Miscellaneous[v]:4[i],	NR	75 [250[s]] (<30–810)	NR
Lund 1989[27] (Denmark)[w]	25	100	56 (24–71)	Ovarian: 25	Symptoms relieved 32% (8/25)	32% (8/25)	32% (8/25) Wound: 6	Re-obstruction 38% (3/8)	68 [273[s]] (7–919)	NR

Study Name	N	% Female	Median Age Years (Range)	Primary Cancer	Palliative Outcomes	Post-operative Mortality	Post-operative Complications	Adverse Outcomes	Survival in Days Median [Mean] (Range)	Length of Stay in Days Median [Mean] (Range)
							Systemic: 2			
Rubin 1989[28] (United States)	52	100	53.8[j] (25–82)	Ovarian: 52	Diet 65% (34/52) Home 87% (45/52)	17% (9/52)	15% (8/52) Bowel: 6 Infectious: 2	Operations 4% (2/52)	NR [174] (0.5–1110)	NR
Bais 1995[29] (Netherlands)[w]	19	100	53 (29–74)	Ovarian: 19	Diet 68% (13/19)	11% (2/19)	32% (6/19) Wound: 2 Infectious: 4	Re-obstruction 21% (4/19) Operations 5% (1/19)	109 [260[s]] (15–775)	NR [24] (NR)
Jong 1995[30] (Canada)	53	100	NR	Ovarian: 53	Symptoms relieved 68% (36/53) Home 68% (36/53)	32%[x] (17/53)	NR	Re-obstruction 40% (21/53)	87.5 [271[s]] (5–892)	NR
Pothuri 2003[31] (United States)	64	100	57[j] (29–79)	Ovarian: 64	Diet 58% (37/64)	6% (4/64)	22% (15/68)[y] Bowel: 5 Infectious: 8 Systemic: 2	Re-obstruction 6% (4/64) Operations 6% (4/64)	237 [NR] (NR)	*Bowel resection*[z] NR [14.3] (5–59) *Ex lap only*[z] NR [12.5] (5–31)
Mangili 2005[32] (Italy)[w]	27	100	54.8[j] (31–77)	Ovarian: 47	Diet 59% (16/27)	22% (6/27)	33% (9/27) Wound: 4 Bowel: 2 Systemic: 3	Operations 0% (0/27)	NR [79] (9–350)[aa]	NR
Chi 2009[33] (United States)[w]	14	100	54 (22–81)[m]	Ovarian: 14	Symptoms relieved 100% (14/14)	NR	7% (1/14)	Re-obstruction *60 days*[r] 29% (4/14) *90 days*[r] 36% (5/14)	191 [339[s]] (33–902)	11 [16[s]] (1–43)[bb]
Kim 2009 (Korea)[34]	23	100	<50 years old: 10 ≥50 years old: 13	Ovarian: 23	Diet 48% (11/23)	NR	13% (3/23) Wound: 1 Bowel: 1 Systemic: 1	NR	61% alive at median follow up of 3 months	NR
Kolomainen 2012[35] (England)	90	100	57 (25–85)	Ovarian: 90	Diet 66% (59/90)	18% (16/90)	27% (24/90) Wound: 9 Bowel: 13 Infectious: 1 Systemic: 5 Miscellaneous: 1[i]	Re-obstruction 17% (10/59) Operations 2% (2/90)	90.5 [599[s]] (<1–2190)	NR

[a] Colorectal cancer

[b] GI = carcinoid, esophageal, gastric, duodenal, periampullary, small bowel cancers, tumors of unknown GI origin

[c] Wound = wound infection, wound dehiscence, reoperation to close laparotomy, wound breakdown, parastomal abscess

[d] Not reported

[e] HPB = pancreatic, bile duct, gallbladder

[f] Bowel = enterocutaneous fistulae, enteroperitoneal fistula, enterovaginal fistula, anastomotic leak, early obstruction, leakage from colostomy, high output stoma, stoma retraction

[g] Infectious = intra-abdominal abscess, pulmonary infection/pneumonia, sepsis, bacteremia, urosepsis, line sepsis, fever, cystitis, neutropenic fever with hypotension, bacterial peritonitis

[h] Systemic = Myocardial infarction, intra-abdominal hemorrhage, aspiration, pulmonary embolus, deep vein thrombosis, cardiovascular failure, heart failure, atrial fibrillation, pulmonary edema, pneumothorax, hypercalcemia

[i] Total does not equal the sum of subgroups because either all complications were not reported or selected patients had multiple complications.

[j] Mean

[k] Group 1 = Patients with return of bowel function

[l] Group 2 = Patients without return of bowel function

[m] Three groups included in this study: two operative groups and one control group. For selected columns only the operative groups are reported. See Table 3 for a further discussion of this study.

[n] Group 1 = 20 patients deemed appropriate for surgery with good prognostic features (no palpable masses or ascites, or patients with obstruction as the first sign of malignancy)

[o] Group 2 = 20 patients deemed appropriate for surgery with poor prognostic features (palpable masses and/or ascites)

[p] GYN = ovarian, cervical, uterine, and endometrial cancer, gynecologic malignancies of unspecified type

[q] Other = kidney, bladder, adrenal, breast, GIST, melanoma, prostate, lung, unknown primary, other non-gynecologic visceral cancers, and sarcoma

[r] Time to death or re-obstruction

[s] Estimated

[t] Entire cohort, which includes patients with MBO from peritoneal carcinomatosis or local recurrence

[u] Only patients with MBO from peritoneal carcinomatosis

[v] Miscellaneous = short gut with diarrhea, antibiotic nephrotoxicity, malignant ureteral obstruction, prolonged ileus

[w] This study reported two groups, a surgical group and a control group. Only the results of the surgical group are reported in this table. See Table 3.

[x] 60-day postoperative mortality

[y] 68 operations were performed on 64 patients

[z] The first group is patients who were able to undergo corrective surgery for MBO. The second group is patients who were found to have such extensive peritoneal carcinomatosis that only exploratory laparotomy was performed.

[aa] Overall mean survival for combined surgical and control groups

[bb] Entire cohort, which includes patients treated with operative or endoscopic interventions

Table 2

Comparison of outcomes after palliative surgery or non-operative treatment for malignant bowel obstruction from peritoneal carcinomatosis.

Study	N	Mean Age in Years (Range)	Palliative Outcomes Achieved (%)[a]	30-Day Mortality (%)	Postoperative Complications (%)	Median Days to Death (Range)	P-value (X^2 test)
Van Ooijen 1993[b,21]							
Surgical Group 1[c]	20	55.7 (26–72)	85	NR[e]	NR	154 (29–1086)[f]	<0.001[g]
Surgical Group 2[d]	20	53.2 (26–72)	43	NR	NR	36 (3–151)	
Gastrostomy Tube	25	53.1 (26–72)	90	NR	NR	33 (8–163)	
Chi 2009[33]							
Surgery	14	NR	100	NR	7	191 (33–902)	NR
Endoscopic Treatment[h]	12	NR	75	NR	25	78 (18–284)	
Lund 1989[27]							
Surgery	25	56[i] (24–71)	32	32	32	68 (7–919)	0.3
Nasogastric Drainage	16	59[i] (49–73)	0	35	NR	30 (7–842)	
Bais 1995[29]							
Surgery	19	53[i] (29–74)	68	11	32	109 (15–775)	NR
Nasogastric Drainage	12	61[i] (29–74)	17	83[j]	NR	37 (13–157)	
Mangili 2005[32]							
Surgery	27	54.8 (31–77)	59	22	33	NR	<0.001[l]
Octreotide[k]	20	59.6 (31–77)	30	NR	5	NR	

[a] Relief of obstructive symptoms or ability to tolerate a diet

[b] Includes patients with ovarian, colorectal, cervical, endometrial, gallbladder, and breast cancer. All other studies only include patients with ovarian cancer.

[c] Patients appropriate for surgery with no palpable masses or ascites, or patients with obstruction as the first sign of malignancy.

[d] Patients appropriate for surgery with palpable masses and/or ascites.

[e] Not reported

[f] Median time to death or intervention for re-obstruction

[g] Group 1 compared to gastrostomy tube group, log-rank test.

[h] Either percutaneous endoscopic gastrostomy (PEG) tube or endoscopically-placed colonic stent

[i] Median

[j] 60-day mortality

[k] Octreotide subcutaneous bolus or intravenous infusion starting at 0.3 mg daily until symptoms controlled; max dose 0.9 mg daily, median dose 0.6 mg daily.

[l] Overall survival was calculated using Kaplan-Meier survival curves, and significance assessed by log-rank test.

Table 3

Quality of included studies as assessed by Newcastle-Ottawa Scale (NOS) and type of bias identified.

Study	Design	NOS	Types of Bias (Confounders)
McCarthy[18]	Retrospective case series	***	• Selection (study period, various malignancies, +/− adjuvant therapy) • Performance (study period, various malignancies)
Turnbull[19]	Retrospective case series	***	• Selection (study period, various malignancies, prior operations, unclear inclusion criteria, urgent vs. elective) • Performance (study period, various malignancies, urgent vs. elective)
Lau[20]	Retrospective case series	**	• Selection (study period, +/− adjuvant therapy, urgent vs. elective) • Performance (study period, urgent vs. elective)
Van Ooijen[21]	Retrospective cohort study	***	• Selection (study period, various malignancies, +/− adjuvant therapy, unclear inclusion criteria, crossover between groups) • Performance (study period, various malignancies, +/− postoperative chemotherapy, crossover between groups) • Detection (crossover between groups)
Blair[22]	Retrospective case series	***	• Selection (unclear inclusion criteria)
Legendre[23]	Retrospective case series	**	• Selection (study period, various malignancies, +/− adjuvant therapy, unclear inclusion criteria) • Performance (study period, various malignancies) • Detection (complications not described, oral intake not described)
Abbas[24,25]	Retrospective case series	***	• Selection (study period, various malignancies, +/− adjuvant therapy, unclear inclusion criteria) • Performance (study period, various malignancies) • Detection (complications not described)
Piver[26]	Retrospective case series	**	• Selection (study period, +/− adjuvant therapy, unclear inclusion criteria) • Performance (study period, variable postoperative chemotherapy)
Lund[27]	Retrospective cohort study	******	• Selection (unclear inclusion criteria)
Rubin[28]	Retrospective cohort study	******	• Selection (+/− adjuvant therapy, unclear inclusion criteria, multiple analyses of patients) • Performance (multiple analyses of patients) • Detection (multiple analyses of patients)

Study	Design	NOS	Types of Bias (Confounders)
Bais[29]	Retrospective cohort study	*****	• Selection (study period, +/− adjuvant therapy) • Performance (study period, +/− postoperative chemotherapy)
Jong[30]	Retrospective case series	***	• Selection (study period, +/− adjuvant therapy, unclear inclusion criteria) • Performance (study period) • Detection (complications not described)
Pothuri[31]	Retrospective case series	***	• Selection (+/− adjuvant therapy, unclear inclusion criteria, multiple analyses of patients) • Performance (+/− postoperative chemo- and radiotherapy, multiple analyses of patients) • Detection (multiple analyses of patients)
Mangili[32]	Retrospective cohort study	*****	• Selection (unclear study period) • Performance (unclear study period)
Chi[33]	Prospective cohort study	*****	• Selection (+/− adjuvant therapy, unclear inclusion criteria) • Performance (+/− postoperative chemotherapy)
Kim[34]	Retrospective case series	**	• Selection (study period, unclear inclusion period) • Performance (study period) • Attrition (patients with limited follow up/lost to follow up)
Kolomainen[35]	Retrospective case series	**	• Selection (study period, +/− adjuvant therapy, unclear inclusion criteria) • Performance (study period, +/− postoperative chemotherapy)