Care of the Open Abdomen After Cytoreductive Surgery and Hyperthermic Intraperitoneal Chemotherapy for Peritoneal Surface Malignancies

Deena Damsky Dell, MSN, RN-BC, AOCN®, LNC, Jeanne Held-Warmkessel, MSN, RN, ACNS-BC, AOCN®, Pamela Jakubek, MSN, RN, CWOCN, and Tina O'Mara, BSN, RN, CWOCN

A patient with a mucinous appendiceal cancer presents to the surgeon complaining of abdominal discomfort and nausea. Having undergone a prior right hemicolectomy, the patient has been disease free and on surveillance with clinical and carcinogenic antigen (CEA) monitoring. The CEA was noted to be elevated and a computed tomography scan revealed peritoneal nodules throughout the abdomen with a presumptive diagnosis of pseudomyxoma peritonei (progressive peritoneal implants from a mucinous primary). Several therapeutic options were offered and the patient selected to undergo cytoreductive surgery (CRS) with the potential to receive hyperthermic interoperative chemotherapy (HIPEC). Extensive resection was performed, including removal of the entire greater omentum, partial gastrectomy, and total pelvic exenteration with end colostomy and ileal conduit. Reassessment of the peritoneal cavity after the resections revealed almost complete cytoreduction. HIPEC was performed with mitomycin C and, after drainage and abdominal washing, the intestinal segments were anastomosed and the abdominal wall closed. Seven days postoperatively, an acute abdomen with septic shock developed as a result of a leak from the ileocolonic anastomosis. The patient returned to the operating room and an exploratory laparotomy, a small bowel resection, a resection of the ileocolonic anastomosis, and an abdominal washout were performed. Edema of the bowel caused by peritonitis resulting from the anastomotic leak necessitated delayed closure of the abdominal wall. A temporary abdominal closure using the ABThera™ Open Abdomen Negative Pressure Therapy system was applied and the abdomen was eventually closed.

Selected patients with extensive intraperitoneal malignancies such as gastrointestinal or gynecologic cancers or sarcomas may be candidates for a radical surgical intervention consisting of CRS with HIPEC. These diagnoses have a dismal prognosis with high recurrence rates after traditional surgical debulking and systemic chemotherapy. Although no data are available from randomized clinical trials, evidence suggests that this aggressive approach is associated with improved survival when compared to systemic chemotherapy (de Bree & Helm, 2012; Elias et al., 2009; Gonzalez-Moreno, Gonzalez-Bayon, & Ortega-Perez, 2012; Helm, 2012; Yan, Black, Savady & Sugarbaker, 2006). In fact, for selected patients, CRS and HIPEC provide the only chance for long-term survival (Gonzalez-Moreno, Gonzalez-Bayon, & Ortega-Perez, 2010).

Rationale

The rationale for using intraperitoneal therapy is to expose residual and microscopic disease to the direct cytotoxic effects of chemotherapy and hyperthermia. Intraperitoneal chemotherapy provides a high concentration of drug regionally while avoiding high systemic blood levels. Clearance of the drug from the peritoneum is slowed by the peritoneal plasma barrier, which maintains a constant high gradient between the peritoneal cavity and the plasma compartment. In addition, the molecular weight and affinity for water (hydrophilicity) of the chemotherapy further slow the passage of drugs through this barrier. The portal vein drains blood from the peritoneal surface directly to the liver for metabolism (first pass, detoxifying effect) and, therefore, systemic drug exposure is reduced even more. First pass metabolism also increases exposure of any hepatic metastases to the chemotherapy (de Bree & Helm, 2012; Gonzalez-Moreno et al., 2010).

A disadvantage to HIPEC is that the chemotherapy can only penetrate tissues to a depth of 3–5 mm. Therefore, cytoreduction must be completed prior to installation of the chemotherapy. All visible disease must be removed. The largest amount of residual tumor diameter acceptable is 2.5 mm, which is considered the threshold of eligibility for HIPEC (Gonzalez-Moreno et al., 2010).

Hyperthermia (in the range of 41°C–43°C) has cytotoxic activity on malignant cells. Hyperthermia decreases blood flow (at times to the point of vascular stasis) and decreases or inhibits oxidative metabolism. That limits tumor growth and results in accumulation of lactic acid. The acidotic environment increases lysosomal activity, which further increases the sensitivity of mitochondrial membranes to the chemotherapy. The increased cell membrane permeability and improved membrane transport allows increased drug penetration. When hyperthermia is combined with cytotoxic drugs, the effect is synergistic and cytotoxicity is greater than what would be expected from additive effects alone (Gonzalez-Moreno et al., 2010).

Preoperative Considerations and Technique

CRS with HIPEC is a high-risk procedure. Morbidity has been reported to be

ONF, 41(4), 438–441.
doi: 10.1188/14.ONF.438-441

as high as 22%–40%, and mortality rates as high as 10% (median is 3%) (de Bree & Helm, 2012), with prolonged hospital stays (an average of 29 days). The surgery is lengthy (6–20 hours), so patients experience prolonged anesthesia and immobility. Patient selection is essential with a focus on adequate cardiac and pulmonary function as well as good performance status. Because postoperative nutrition is a major challenge, patients should have a nutritional assessment prior to surgery and preoperative albumin needs to be greater than 3 gm/dl (de Bree & Helm, 2012; Wooten, 2009).

With CRS, the extent of the disease is initially assessed via an exploratory laparotomy and, if too extensive, CRS is aborted. The abdominal incision extends from xiphoid to pubis. A right colectomy and total omentectomy is always done and, very often, a sigmoid colectomy and/or low anterior resection are needed. Peritoneal surfaces are stripped of any visible disease. HIPEC is instilled before any reconstruction or re-anastomoses are done. The purpose of this is to decrease the chance of anastomotic or staple line recurrence (Gonzalez-Moreno et al., 2010). After the completion of the CRS, HIPEC may be administered by either the open or the closed method, as determined by the surgeon; however, the closed method reduces operating room staff exposure to chemotherapy. Equipment that heats and circulates the chemotherapy at a stable temperature during the procedure is required.

Drug Choice and Safety Concerns

Antineoplastic selection for HIPEC is essential. In addition to antineoplastic characteristics discussed earlier in this article, the agent selected needs to be active for the patient's tumor type, have direct cytotoxic activity, and tolerated by the abdominal cavity and its contents (de Bree & Helm, 2012; de Bree & Tsiftsis, 2007b). Additional useful characteristics include heat stability, heat synergy, and rapid renal clearance (de Bree & Tsiftsis, 2007b). Agents used in HIPEC include mitomycin, platinum compounds, and taxanes (de Bree & Tsiftsis, 2007a). Patients require post-chemotherapy monitoring for hematologic and renal toxicity in addition to facility-required post-chemotherapy handling precautions (see Figure 1).

Nursing Care: Watching for Complications

The most serious complications are prolonged ileus, anastomotic leaks, intestinal perforations, fistula formation, abscess formation, pancreatitis, bleeding, wound infections with dehiscence, and renal failure. As many as 16% of patients require reoperation for complications (de Bree & Helm, 2012). The most fatal complication is perforation or anastomotic leakage in the presence of leukopenia. Early recognition of sepsis is crucial. Patients require intensive care nursing for an average of 1–8 days. A quarter of the patients require vasopressor support (Cooksley & Haji-Michael, 2011). Fluid and electrolyte balance and central venous pressure readings need to be monitored closely. Coagulopathy peaks at 24 hours and is usually dilutional in origin because of the massive fluid volume resuscitation. Fresh frozen plasma or packed red blood cells may be needed. The greatest risk for neutropenia is 6–7 days postoperatively, and neutropenia responds to granulocyte colony-stimulating factor. Serum albumin is usually low from massive protein loss during surgery and intake may be further compromised by ileus and nausea. Total parenteral nutrition initially is needed from the prolonged ileus. Dietary counseling is required to ensure the patient can maintain oral intake at discharge (Cooksley & Haji-Michael, 2011; de Bree & Helm, 2012; Wooten, 2009)

Challenge: Nursing Care of the Open Abdomen

The abdomen may remain opened postoperatively in three situations: (a) management of sepsis of the intra-abdominal cavity, (b) prevention or treatment of abdominal compartment syndrome, and (c) control of intra-abdominal bleeding (Demetrios & Salim, 2014). In the case study discussed at the beginning of this article, the goals for the patient were to manage sepsis and to prevent abdominal compartment syndrome. The syndrome results from massive intraoperative fluid resuscitation causing retroperitoneal and viscera edema and fascia ischemia (Turza et al., 2012). Abdominal compartment syndrome can result in cardiac collapse, and multi-organ failure frequently follows cardiac dysfunction from the decreased venous return (Turza et al., 2012).

Leaving the abdomen open helps preserve the fascia for eventual surgical closure, in addition to controlling bacteria and toxins, reducing the inflammatory process (Turza et al., 2012) and allowing re-exploration and additional washouts of infectious materials (Franklin, Alvarez, & Russek, 2012). As edema and bowel distension resolve, the abdominal muscles retract laterally. Temporary abdominal closure systems provide protection of the viscera while preventing the retraction of the abdominal muscles (Quyn et al., 2012). To successfully manage an open abdomen, any complications must be identified and treated promptly (Franklin et al., 2012). The use of an open management system can minimize the following complications (Demetrios, 2012; Demetrios & Salim, 2014).

- Enterocutaneous fistula and loss of bowel function
- Fascial retractions and loss of abdominal domain
- Infection, sepsis, internal abscess, and bleeding
- Fluid and protein loss, as well as malnutrition
- Immobility sequela
- Hypothermia
- Subsequent large incisional hernia

Historically, management of the open abdomen was associated with high morbidity and mortality, but improvements in technique mainly involving negative pressure therapy have improved outcomes (Quyn et al., 2012). Multiple management systems are available. The challenge of all systems is to protect underlying bowel and other structures. Vacuum-assisted closure (VAC) systems have demonstrated the lowest mortality

- Use the facility's post-chemotherapy excretion precaution procedures.
- Administer a prescribed granulocyte colony-stimulating factor.
- Monitor urine output and renal function tests.
- Monitor respiratory status and for signs and symptoms of pneumonia.
- Monitor for and manage nausea, vomiting, and diarrhea.
- Educate the patient to report signs and symptoms of infection or bleeding and how to avoid injury.

Figure 1. Post-Chemotherapy Patient Monitoring

Note. Based on information from Elias et al., 2010; Helm, 2012; Witkamp et al., 2001.

Cytoreductive Surgery With Hyperthermic Intraperitoneal Chemotherapy

- Cytoreductive surgery with hyperthermic intraperitoneal chemotherapy offers selected patients an opportunity for long-term survival.
- Chemotherapeutic agents used are non-cell cycle specific, such as mitomycin C.
- Systemic chemotherapy-associated serious adverse events compound surgical-associated complications.
- The most serious postoperative complications are intra-abdominal and include prolonged ileus, anastomotic leaks, and bowel perforations.
- Astute nursing assessment and management are required for the prompt recognition of surgical and chemotherapy-associated life-threatening toxicities and serious adverse events.
- ABThera™ is an effective way to maintain an open abdomen until surgical closure is possible.

Bibliography

Cooksley, T., & Haji-Michael, P. (2011). Post-operative critical care management of patients undergoing cytoreductive surgery and heated intraperitoneal chemotherapy (HIPEC). *World Journal of Clinical Oncology, 9*, 169.

Gonzalez-Moreno, S., Gonzalez-Bayon, L.A., & Ortega-Perez, G. (2010). Hyperthermic intraperitoneal chemotherapy: Rationale and technique. *World Journal of Gastrointestinal Oncology, 2*(2), 68–75.

Mendez-Eastman, S. (2006). Vacuum assisted closure advanced therapy system troubleshooting guide. *Plastic Surgical Nursing, 26,* 37–39.

Turza, K.C., Campbell, C.A., Rosenberger, L.H., Politano, A.D., Davies, S.W., Ricio, L.M., & Sawyer, R.G. (2012). Options for closure of the infected abdomen. *Surgical Infections, 13,* 343–351.

rates and provide protection of organs, prevention of evisceration, assistance with fluid management, reduction of loss of domain, and allow frequent abdominal exploration required to resolve intra-abdominal infection (Franklin et al., 2012; Quyn et al., 2012). A VAC system of the open abdomen consists of a nonadherent sheet to cover the exposed viscera with the sponge section of the dressing placed over the nonadherent film. Both are then sealed with a transparent dressing and connected to negative pressure. The system uses principles of traction with countertraction, which prevents abdominal wall retraction and allows for subsequent closure of the abdomen (Turza et al., 2012).

ABThera is a closed system providing negative pressure wound therapy (NPWT) within the abdomen. The NPWT dressing has a visceral protective layer that is trimmed to fit the abdominal cavity, cover the viscera, and protect the abdominal contents while managing the excess peritoneal fluid (Demetrios, 2012) (see Figure 2). Studies have demonstrated fewer complications with the ABThera versus other VAC systems (Turza et al., 2012). Nursing assessment of the open abdomen with ABThera dressing in place should include the following (Mendez-Eastman, 2006).

- Integrity of dressing: Ascertain that TRAC™ is secure and foam is collapsed; secure edges of dressing with additional transparent dressing/drape.
- Integrity of pump: Pump settings are accurate as ordered; change canister when full; respond to alarms.
- Drainage/output: Monitor for bleeding or fistula-like drainage.

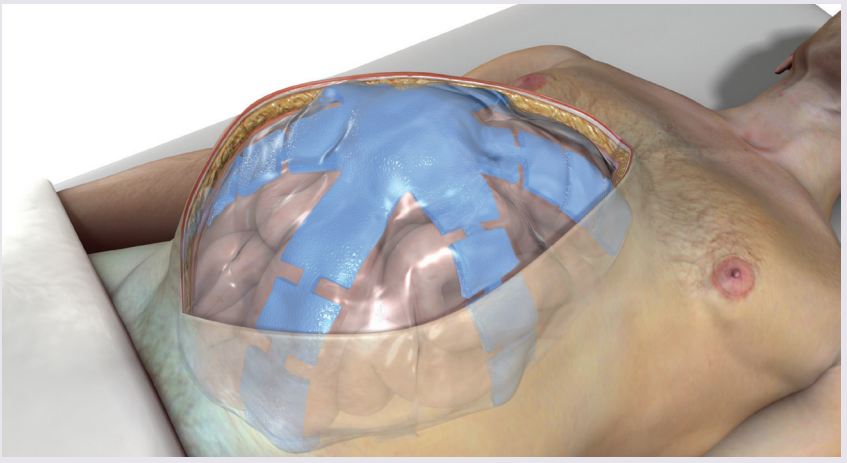

Figure 2. Negative Pressure Therapy Dressing Covering the Abdomen

Note. Image courtesy of KCI Licensing, Inc. Used with permission.

Conclusion

The patient returned to the operating room three days later to have the ABThera changed, another washout, and wound edges re-approximated. The operative procedure was well tolerated, allowing resolution of sepsis. The abdominal wall defect was closed six days later.

Deena Damsky Dell, MSN, RN-BC, AOCN®, LNC, is a clinical nurse specialist in critical care, Jeanne Held-Warmkessel, MSN, RN, ACNS-BC, AOCN®, is a clinical nurse specialist in medical oncology nursing, Pamela Jakubek, MSN, RN, CWOCN, is a clinical nurse specialist and wound ostomy continence nurse, and Tina O'Mara, BSN, RN, CWOCN, is a wound ostomy continence nurse, all at Fox Chase Cancer Center/Temple Health in Philadelphia, PA. No financial relationships to disclose. Dell can be reached at deena.dell@fccc.edu, with copy to editor at ONFEditor@ons.org.

Key words: cytoreductive; hyperthermic intraperitoneal chemotherapy; surgery

References

Cooksley, T., & Haji-Michael, P. (2011). Post-operative critical care management of patients undergoing cytoreductive surgery and heated intraperitoneal chemotherapy (HIPEC). *World Journal of Clinical Oncology, 9*, 169.

de Bree, E., & Helm, C.W. (2012). Hyperthermic intraperitoneal chemotherapy in ovarian cancer: Rational and clinical data. *Expert Reviews in Anticancer Therapy, 12*, 895–911.

de Bree, E., & Tsiftsis, D.D. (2007a). Experimental and pharmacokinetic studies in intraperitoneal chemotherapy: From laboratory bench to bedside. *Recent Results in Cancer Research, 169,* 53–73.

de Bree, E., & Tsiftsis, D.D. (2007b). Principles of perioperative intraperitoneal chemotherapy for peritoneal carcinomatosis. *Recent Results in Cancer Research, 169,* 39–51.

Demetrios, D. (2012). Total management of the open abdomen. *International Wound Journal, 9*(Suppl. 1), 17–24.

Demetrios, D., & Salim, A. (2014). Management of the open abdomen. *Surgical Clinics of North America, 94,* 131–153. doi:10.1016/j.suc.2013.10.010

Elias, D., Gilly, F., Boutitie, F., Quenet, F., Bereder, J.M., Mansvelt, B., . . . Glehen, O. (2010). Peritoneal colorectal carcinomatosis treated with surgery and perioperative intraperitoneal chemotherapy: Retrospective analysis of 523 patients from a multicentric French study. *Journal of Clinical Oncology, 28,* 63–68.

Elias, D., Lefevre, J.H., Chevalier, J., Brouquet, A., Marchal, F., Classe, J.M., . . . Bonastre, J. (2009). Complete cytoreductive surgery plus intraperitoneal chemohyperthermia with oxaliplatin for peritoneal carcinomatosis of colorectal origin. *Journal of Clinical Oncology, 27,* 681–685. doi:10.1200/JCO.2008.19.7160

Franklin, M.E., Alvarez, A., & Russek, K. (2012). Negative pressure therapy: A viable option for general surgical management of the open abdomen. *Surgical Innovation, 19,* 353–363. doi:10.1177/1553350611429693

Gonzalez-Moreno, S., Gonzalez-Bayon, L.A., & Ortega-Perez, G. (2010). Hyperthermic intraperitoneal chemotherapy: Rationale and technique. *World Journal of Gastrointestinal Oncology, 2*(2), 68–75.

Gonzalez-Moreno, S., Gonzalez-Bayon, L.A., & Ortega-Perez, G. (2012). Hyperthermic intraperitoneal chemotherapy methodology and safety considerations. *Surgical Oncology Clinics of North America, 21,* 543–557. doi:10.1016/j.soc.2012.07.001

Helm, C. (2012). Current status and future directions of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy in the treatment of ovarian cancer. *Surgical Oncology Clinics of North America, 21,* 645–663. doi:10.1016/j.soc.2012.07.007

Mendez-Eastman, S. (2006). Vacuum assisted closure advanced therapy system troubleshooting guide. *Plastic Surgical Nursing, 26,* 37–39.

Quyn, A.J., Johnston, C., Hall, D., Chambers, A., Arapova, N., Ogston S., & Amin, A.I. (2012). The open abdomen and temporary abdominal closure systems-historical evolution and systematic review. *Colorectal Disease, 14,* 429–438.

Turza, K.C., Campbell, C.A., Rosenberger, L.H., Politano, A.D., Davies, S.W., Ricio, L.M., & Sawyer, R.G. (2012). Options for closure of the infected abdomen. *Surgical Infections, 13,* 343–351.

Witkamp, A.J., de Bree, E., Van Goethem, A.R., & Zoetmulder, F.A. (2001). Rationale and techniques of intra-operative hyperthermic intraperitoneal chemotherapy. *Cancer Treatment Reviews, 27,* 365–374.

Wooten, L. (2009). Appendix B: Nursing care of the HIPEC patient. *Current Problems in Cancer, 33,* 227–237. doi:10/1016/j.currproblcancer.2009.06.007

Yan, T., Black, D., Savady, R., & Sugarbaker, P. (2006). Systemic review on the efficacy of cytoreductive surgery combined with perioperative intraperitoneal chemotherapy for peritoneal carcinomatosis from colorectal carcinoma. *Journal of Clinical Oncology, 24,* 4011–4019. doi:10.1200/JCO.2006.07.1142

Do You Have an Interesting Clinical Experience to Share?

Clinical Challenges provides readers with a forum to discuss creative clinical solutions to challenging patient care issues. Case studies or descriptions may be submitted with or without discussion or solutions. Materials or inquiries should be directed to *Oncology Nursing Forum* Associate Editor Anne Marie C. Flaherty, MSN, RN, APNc, at aflaherty@HackensackUMC.org.