Outcomes from cytoreduction and HIPEC for appendiceal epithelial neoplasms

Authors: Vignesh Narasimhan FRACS^{1,3}, Toan Pham FRACS^{1,3}, Satish Warriar FRACS, MS¹, A Craig Lynch FRACS, MS¹, Michael Michael FRACP, MD², Jeanne Tie FRACP, MD², Robert Ramsay PhD^{1,3}, Alexander Heriot FRACS, MD^{1,3}

Affiliations:

¹ Peter MacCallum Cancer Centre, Department of Surgical Oncology

² Peter MacCallum Cancer Centre, Department of Medical Oncology

³ Sir Peter MacCallum Dept. of Oncology, University of Melbourne

Corresponding author:

- Name: Dr. Vignesh Narasimhan
- Email: vignesh.narasimhan@petermac.org
- Phone: 045121766

This manuscript has 2109 words (excluding abstract, figure legend and references) and contains two figures and two tables.

Short Title: CRS and HIPEC for appendiceal neoplasms

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1111/ans.14985](https://doi.org/10.1111/ans.14985)

Key words: pseudomyxoma peritonei, peritonectomy, cytoreduction, hyperthermic intraperitoneal chemotherapy, appendiceal neoplasm

Conflicts of interest and disclosures:

The Authors have no conflicts of interest.

Dr Vignesh Narasimhan is a PhD Student and is a recipient of the Royal Australasian College of Surgeons Foundation for Surgery Research Grant, Colorectal Surgical Society Research Grant, NHMRC postgraduate scholarship and Peter MacCallum Foundation Scholarship outside the submitted manuscript.

Dr Toan Pham is a PhD Student and is a recipient of the Royal Australasian College of Surgeons Research Scholarship and Peter MacCallum Foundation Research Grant, outside the submitted manuscript.

Abstract

BACKGROUND

Appendiceal epithelial neoplasms are rare cancers. Management of peritoneal disease from appendiceal neoplasms has historically been with debulking surgery. In recent decades, the advent of cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC) has become the standard of care. Here, we report our single institution ten-year experience with CRS and HIPEC for appendiceal neoplasms.

METHODS

This is a retrospective review from 1 January 2008 to 1 June 2017 of all patients undergoing CRS and HIPEC for appendiceal neoplasms. Institutional ethics approval was granted for this project.

RESULTS

One hundred and seventy two patients underwent two hundred and eight cytoreductive surgeries during this time. Overall, 83.72% of patients had one CRS and HIPEC procedure. Pseudomyxoma peritonei from a perforated appendiceal mucinous neoplasm accounted for 67.9% of cases. The median Peritoneal Carcinomatosis Index (PCI) was 14, with complete cytoreduction achieved in 74.2% of patients. Fifty four percent of patients had at least one complication, with one (0.5%) peri-operative mortality in our cohort. For the entire cohort, the median overall survival was 104 months and a five -year survival of 75%. In those having a complete cytoreduction, 5-year survival was 90%, with a median disease free interval of 63 months. PCI and completeness of cytoreduction were independent predictors of overall survival.

CONCLUSION:

Our results demonstrate that CRS and HIPEC for appendiceal neoplasms is safe and effective. Despite carrying some morbidity, it offers patients an excellent disease free and overall survival.

(Abstract 238 words)

Introduction

Appendiceal epithelial neoplasms are rare cancers, accounting for approximately 1% of all colorectal cancers¹. They are histologically diverse, with differing degrees of invasiveness. Seventy five percent show indolent growth, causing symptoms only after many years. A small proportion however, are more aggressive and can cause early death if not dealt with promptly¹.

The most common and well known appendiceal peritoneal condition is Pseudomyxoma Peritonei (PMP). PMP is a clinical syndrome characterised by the accumulation of mucinous and gelatinous ascites, most commonly caused by a perforated mucinous neoplasm of the appendix. It is a relatively rare entity with a documented incidence of 2-3 cases per million per year^{2,3}. This rate has stayed relatively constant over the years. However, left untreated, it can have devastating consequences.

Management of peritoneal disease from appendiceal epithelial tumours has historically been with debulking surgery. Gough et al. in 1994 reported a 53% and 32% five and ten-year survival respectively, after debulking surgery and selective intraperitoneal chemotherapy for PMP from tumours of the appendix or ovary⁴. Miner et al. reported a 21% 10 year survival after loco-regional debulking surgery for pseudomyxoma from appendix tumours⁵. In recent years, the advent of cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC) has provided a more tailored approach to these tumours, providing patients with good disease free and overall survival. Pioneered by Sugarbaker, and popularised in the 1990s and 2000s^{1,6}, CRS and HIPEC has become the standard of care for peritoneal disease from appendiceal epithelial malignancies. An international consensus statement supports the use of CRS and

HIPEC as standard of care for pseudomyxoma peritonei from appendiceal neoplasms⁷.

CRS and HIPEC is performed only at a handful of centres within Australia and New Zealand. Given its uncommon incidence, few centres have built large volumes to enable reporting of outcomes. One centre in Sydney, Australia has previously reported on its experience with PMP, reporting a 75% and 36% five and ten-year median survival for PMP following CRS and HIPEC^{8,9}.

The aim of this study was to review our ten-year experience and outcomes from CRS and HIPEC for predominantly PMP from perforated appendiceal mucinous neoplasms and other appendiceal epithelial malignancies, and assess short-term morbidity, long-term survival, and prognostic factors.

Methods

Patients and inclusion criteria

Data was prospectively collected on the peritoneal disease database maintained at our institution and analysed retrospectively. All patients undergoing CRS and HIPEC for appendiceal neoplasms from January 1, 2008 to 1 June 2017 were included in the study. Patient sex, age, tumour marker levels, American Society of Anaesthetologists (ASA) score, details of prior related operations were recorded.

Peri-operative management

All patients were pre-operatively assessed with a full history and examination. Tumour markers (CEA and CA 19.9), along with a computed tomography (CT) scan of the chest, abdomen and pelvis were performed on all patients. Since 2010, patients also underwent a routine FDG Positron Emission Tomography (PET)/CT as part of the pre-operative workup. All patients were discussed at the peritoneal disease multidisciplinary meeting. Diagnostic laparoscopy was selectively performed for adenocarcinoma histology if tumour burden on imaging was unclear. Early in the institutes practice, CRS and HIPEC was only offered for adenocarcinoma histology for PCI <15.

Post-operatively, most patients were routinely transferred to intensive care. Routine chest physiotherapy and an early recovery after surgery (ERAS) based postoperative care program was implemented. This broadly involved early oral intake, with diet upgraded as tolerated. Nasogastric tube (NGT) was not used routinely. Total parenteral nutrition (TPN) was commenced on day seven if there was ongoing evidence of postoperative ileus.

No post-operative intraperitoneal chemotherapy (EPIC) was administered.

Diagnoses

Diagnosis was based on the histology reported by the Peter MacCallum gastrointestinal pathologist. The list of diagnoses were:

1. Pseudomyxoma Peritonei (PMP): in this manuscript, PMP refers solely to the clinical syndrome of mucinous or gelatinous ascites caused by a perforated mucinous neoplasm of the appendix
2. Appendiceal mucinous adenocarcinoma
3. Appendiceal – other (including colonic type adenocarcinoma, signet ring cell adenocarcinoma, adenocarcinoma ex goblet cell carcinoid)

Cytoreductive Surgery and HIPEC

A midline laparotomy was performed in all patients. Following meticulous adhesiolysis, an assessment of the peritoneal carcinomatosis index (PCI) was conducted. Cytoreductive surgery was performed in keeping with Sugarbaker's techniques^{1, 10}. Visceral resections involved segmental colectomy, rectal resections, small bowel resections, cholecystectomy, splenectomy, partial or very rarely total gastrectomy, and hysterectomy with bilateral salpingo-oophorectomy in females. Peritoneal stripping of the pelvis and diaphragm were recorded when performed. Cytoreduction score (CC score) was recorded for every case. CC-0 implied no visible disease was remaining. CC-1 implied remaining disease less than 2.5mm. CC-2 implied residual disease was 2.5mm-2.5cm, and CC-3 represented residual disease greater than 2.5cm in size. CC-0/1 was considered complete cytoreduction and was followed by HIPEC. CC-2/3 cases were deemed incomplete cytoreduction and were not given HIPEC, except in selected cases, such as significant ascites. HIPEC was administered via open coliseum technique. Mitomycin C (15mg/m²) was the standard drug used for HIPEC for PMP, along with concurrent intravenous 5-FU (400mg/m²). In selected

cases, Oxaliplatin (350mg/m²) was used instead of Mitomycin C. Oxaliplatin was used mainly in patients with adenocarcinoma histology.

Complications

Complications were recorded in keeping with the Clavien-Dindo classification. Grades I and II were grouped together and Grades III, IV and V separately reported.

Statistical analyses

All data was de-identified and analysed using IBM® SPSS® version 22 and Microsoft® Excel®. Continuous variables were expressed as medians with ranges. Categorical variables were expressed as numbers with percentages. Kaplan-Meier survival analysis was performed to calculate overall survival (OS) and relapse free survival (RFS). Overall survival was calculated from time of detection of peritoneal metastases to last follow up. Relapse free survival was calculated from time of CRS and HIPEC surgery to last follow up. Log rank test was used to assess statistical significance. Factors affecting survival were identified using univariate analysis. Multivariate logistic regression analysis was performed to identify factors independently affecting overall survival.

Ethics

Institutional ethics approval was provided for this project (PMCC 17/173R).

Results

Demographic and operative data

One hundred and seventy two patients underwent two hundred and eight cytoreductive surgeries during this period. Patient characteristics are shown in Supplementary Table 1. The median age at operation was 55.6 years with a female preponderance (59.3%).

144 of 172 patients (83.72%) had one CRS and HIPEC procedure whilst 28 patients with recurrence underwent more than one CRS and HIPEC procedure. PMP, from a perforated appendiceal mucinous neoplasm was the most common reason for CRS and HIPEC (67.9%), with appendiceal mucinous adenocarcinoma accounting for 41 cases (19.6%). Rarer diagnoses such as appendiceal adenocarcinoma ex goblet cell carcinoid, non-mucinous appendiceal adenocarcinoma and appendiceal signet cell adenocarcinoma accounted for the remainder. The median length of stay for patients was 11 days. The median PCI for the entire cohort was 14, with a median PCI of 16 for PMP and 8 for appendiceal mucinous adenocarcinoma. Complete cytoreduction (CC 0/1) was achieved in 155 cases (74.2%), and incomplete cytoreduction in the remaining 54 (25.8%) cases. Ten cases (4.8%) underwent laparotomy and biopsy only due to burden of disease. HIPEC was used in 98% of cases where complete cytoreduction was achieved, as well as 11% of cases with incomplete cytoreduction. Mitomycin C was the most commonly used drug for HIPEC in 129 cases (81.65%), with Oxaliplatin used in 29 cases (18.35%). The median length of CRS and HIPEC operations was 280 minutes (range 60 to 720 minutes)

Resections and Morbidity

Peri-operative details and complications are shown in Table 1 and Supplementary Table 2. Visceral resections were common, with colectomies performed in 132 (63.2%) cases, hysterectomy/oophorectomy in 49 (23.4%) cases, with 25 (11.96%) cases requiring a stoma. Diaphragmatic and pelvic peritonectomy was performed in 60 (28.7%) and 70 (33.5%) cases, respectively. The majority of cases required one anastomosis (56.5%), with a small proportion requiring two or more anastomoses (12%).

One hundred and thirteen of 208 operations (54%) had at least one complication. Clavien Dindo Grade I/II complications were most common, occurring in 39.7% of cases. 84 cases (40.4%) had at least one Grade 3/4 complication, with intra-abdominal collections (12.9%), wound related issues (19.1%) and respiratory complications (12.4%) the most common. There was one peri-operative in-hospital mortality (0.5%) caused by respiratory failure.

Survival Outcomes

Median follow up for all cases was 37 (range 3-120) months. Median OS for all cases was 104 months, with a 75% five- and 40% ten-year survival (Figure 1a). Patients with PMP and appendiceal mucinous carcinoma had a 78% and 85% five-year survival respectively (Figure 1b). We observed a significantly better OS in patients with PCI < 20 compared to those with PCI > 20 ($p < 0.05$, Figure 2a). Additionally, five-year survival was significantly different based on cytoreduction score, with CC 0/1 achieving a 90% five-year survival compared to 40% with CC 2/3 (Figure 2b). The median RFS following complete cytoreduction was 63 months (Supplementary Figure 1a). There was no significant difference in RFS between appendiceal tumour types (Supplementary Figure 1b).

On univariate analysis, presence of signet ring cells, ASA and PCI at operation was associated with overall survival. Multivariate analysis identified lower PCI and completeness of cytoreduction as independent predictors of overall survival.

Discussion

CRS and HIPEC is recognised as the standard of care for peritoneal disease from appendiceal epithelial malignancies in many countries^{11, 12}. The results show a favorable 5-year survival of 75%, with a median OS of 104 months. Complete cytoreduction improves 5-year survival to 90%, with a RFS of 63 months. However, 5-year survival was only 42% if an incomplete cytoreduction (CC 2/3) was achieved. Lower PCI and complete cytoreduction were independently associated with improved overall survival.

These survival data are largely consistent with other published studies. Recent large volume studies have reported 5-year survival ranging from 69-84%^{2, 13, 14}. Chua et al reported an initial 5-year overall survival of 75%⁸, with 80% and 42% for disseminated peritoneal adenomucinosis (DPAM) and Peritoneal mucinous adenocarcinoma (PMCA) respectively in an updated cohort⁹. Chua et al¹⁵, in a multi-institutional analysis of over two thousand patients, reported 5-year survival rates of 85% and 24% for patients undergoing complete and incomplete cytoreduction, respectively. They also found lower PCI, cytoreduction score, use of HIPEC, histology and post-operative complications as factors associated with survival.

The peritoneal service has been active since 2008 and has progressively increased workload. Case selection has been critical, with PMP being the most common reason for CRS and HIPEC. Patients with PMP achieved a 78% 5-year survival with a median RFS of 67 months if a complete cytoreduction was achieved. Given greater experience with PMP, the median PCI for all PMP cases was 16, compared to a median PCI of 8 for appendiceal mucinous adenocarcinoma. Additionally, PCI was not a limiting factor for operating on patients with PMP, however adenocarcinoma cases were selected based on lower PCI.

While effective, CRS and HIPEC does carry significant morbidity, with over half the cases having at least one complication. While Grade I/II complications were the most common, significant major complications such as intra-abdominal collections, wound and cardio-respiratory complications occurred in 2.9-19.1% of cases. We had one peri-operative mortality (0.5%). These figures are comparable to higher volume studies that have reported morbidity and mortality rates of 7-40% and 2-4% respectively¹³⁻¹⁵. This difference is possibly due to the unit being more selective with cases, with lower numbers of multi-visceral resections, and overall lower PCI referrals.

Our study does have a few limitations that warrant discussion. Firstly, being a retrospective review, it is reliant on the accuracy of the pre-recorded data. We have reviewed all patient records thoroughly to ensure that the data recorded was accurate. Secondly, we have classified PMP on its own, without dividing it into low-grade and high-grade histology as suggested by the consensus from the peritoneal surface malignancy group¹⁶. Therefore, we are unable to further stratify the survival of PMP patients based on the grade of PMP. However, since the consensus statement, our institute reports PMP separately as low and high grade. For the purpose of this study, we have retained PMP as a unified diagnosis to allow for more informative statistical analyses. Various studies have shown that survival is improved with low grade PMP compared to high grade PMP^{2, 17-19}. Nevertheless, the overall management of low and high grade PMP remains the same.

Our study had an overall 4.8% rate of laparotomy and biopsy only, owing to high disease burden. This may be reflective of the surgical learning curve and may reduce further in the future with increasing experience. Exploring new ways to reduce the burden of mucin in these patients with unresectable disease is an

area of intense research, including using novel therapies such as mucolytic agents^{20, 21}.

Conclusion

This single institute review is the second largest cohort reported in Australia. The favorable outcomes despite being a relatively young peritoneal centre further reinforces the concept of CRS and HIPEC being safe and effective for appendiceal neoplasms with good disease free and overall survival. As previously shown, completeness of cytoreduction and lower PCI are associated with the greatest chance of a long-term survival.

References

1. Sugarbaker P. New standard of care for appendiceal epithelial neoplasms and pseudomyxoma peritonei syndrome? *Lancet Oncol.* 2005;7(1):69-76.
2. Ansari N, Chandrakumaran K, Dayal S, Mohamed F, Cecil TD, Moran BJ. Cytoreductive surgery and hyperthermic intraperitoneal chemotherapy in 1000 patients with perforated appendiceal epithelial tumours. *Eur J Surg Oncol.* 2016;42(7):1035-41.
3. Bevan KE, Mohamed F, Moran B. Pseudomyxoma Peritonei. *World J Gastrointest Oncol.* 2010;2(1):44-50.
4. Gough DB, Donohue JH, Schutt AJ, Gonchoroff N, Goellner JR, Wilson TO, et al. Pseudomyxoma peritonei. Long-term patient survival with an aggressive regional approach. *Ann Surg.* 1994;219(2):112-9.
5. Miner TJ, Shia J, Jaques DP, Klimstra DS, Brennan MF, Coit DG. Long-term survival following treatment of pseudomyxoma peritonei: an analysis of surgical therapy. *Ann Surg.* 2005;241(2):300-8.
6. Sugarbaker PH. Peritonectomy procedures. *Ann Surg.* 1995;221(1):29-42.
7. Moran B, Baratti D, Yan T, Kusamura S, Deraco M. Consensus Statement on the Loco-Regional Treatment of Appendiceal Mucinous Neoplasms with Peritoneal Dissemination (Pseudomyxoma Peritonei). *Journal of Surgical Oncology.* 2008;98:277-82.
8. Chua TC, Yan TD, Smigielski ME, Zhu KJ, Ng KM, Zhao J, et al. Long-term survival in patients with pseudomyxoma peritonei treated with cytoreductive surgery and perioperative intraperitoneal chemotherapy: 10 years of experience from a single institution. *Ann Surg Oncol.* 2009;16(7):1903-11.
9. Alzahrani N, Ferguson J, Valle S, Liauw W, Chua T, Morris D. Cytoreductive surgery and hyperthermic intraperitoneal chemotherapy: long-term results at St George Hospital, Australia. *ANZ J Surg.* 2016;86(11):937-41.
10. Sugarbaker PH. Peritonectomy procedures. *Surg Oncol Clin N Am.* 2003;12(3):703-27, xiii.
11. Mohamed F, Cecil T, Moran B, Sugarbaker P. A new standard of care for the management of peritoneal surface malignancy. *Curr Oncol.* 2011;18(2):e84-96.
12. Dube P, Sideris L, Law C, Mack L, Haase E, Giacomantonio C, et al. Guidelines on the use of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy in patients with peritoneal surface malignancy arising from colorectal or appendiceal neoplasms. *Curr Oncol.* 2012;22:100-12.
13. Youssef H, Newman C, Chandrakumaran K, Mohamed F, Cecil TD, Moran BJ. Operative findings, early complications, and long-term survival in 456 patients with pseudomyxoma peritonei syndrome of appendiceal origin. *Dis Colon Rectum.* 2011;54(3):293-9.
14. Elias D, Gilly F, Quenet F, Bereder JM, Sideris L, Mansvelt B, et al. Pseudomyxoma peritonei: a French multicentric study of 301 patients treated

- with cytoreductive surgery and intraperitoneal chemotherapy. *Eur J Surg Oncol*. 2010;36(5):456-62.
15. Chua TC, Moran BJ, Sugarbaker PH, Levine EA, Glehen O, Gilly FN, et al. Early- and long-term outcome data of patients with pseudomyxoma peritonei from appendiceal origin treated by a strategy of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy. *J Clin Oncol*. 2012;30(20):2449-56.
16. Carr NJ, Cecil TD, Mohamed F, Sobin LH, Sugarbaker PH, González-Moreno S, et al. A Consensus for Classification and Pathologic Reporting of Pseudomyxoma Peritonei and Associated Appendiceal Neoplasia: The Results of the Peritoneal Surface Oncology Group International (PSOGI) Modified Delphi Process. *The American Journal of Surgical Pathology*. 2016;40(1):14-26.
17. Huang Y, Alzahrani N, Chua T, Morris D. Histological subtype remains a significant prognostic factor for survival outcomes in patients with appendiceal mucinous neoplasm with peritoneal dessemination. *Diseases of the colon and rectum*. 2017;60(4):360-7.
18. Gupta N, Asif S, Gandhi J, Rajpurohit S, Singh S. Role of CRS and HIPEC in appendiceal and colorectal malignancies: Indian experience. *Indian J Gastroenterol*. 2017;36(2):126-30.
19. Lansom J, Alzahrani N, Liauw W, Morris DL. Cytoreductive Surgery and Hyperthermic Intraperitoneal Chemotherapy for Pseudomyxoma Peritonei and Appendix Tumours. *Indian J Surg Oncol*. 2016;7(2):166-76.
20. Pillai K, Akhter J, Chua TC, Morris DL. A formulation for in situ lysis of mucin secreted in pseudomyxoma peritonei. *International Journal of Cancer*. 2014;134(2):478-86.
21. Akhter J, Pillai K, Chua T, Alzarín N, DL M. Efficacy of a novel mucolytic agent on pseudomyxoma peritoneu mucin, with potential for treatment through peritoneal catheters. *Am J Cancer Res*. 2014;4(5):495-507.

fig 1 appendix paper.JPG

fig 2 appendix paper.JPG

Table 1. Peri-operative details

Detail		Number of cases (median + percentage)
Blood transfusions	Yes	49 (23.4%)
	No	160 (76.6%)
PCI	<10	86 (41.1%)
	10-15	27 (12.9%)
	16-20	16 (7.7%)
	>20	79 (38.0%)
Use of HIPEC		158 (75.6%)
HIPEC drug	Mitomycin C	129 (81.7%)
	Oxaliplatin	29 (18.4%)
CC score	0/1 (complete)	155 (74.2%)
	HIPEC used	152 (96.2%)
	2/3 (incomplete)	54 (25.8%)
	HIPEC used	6 (11.1%)
Median ASA		2 (1-3)
Resections	Colectomy	132 (63.2%)
	Proctectomy	35 (16.7%)
	Small bowel resection	30 (14.4%)
	Hysterectomy/oophorectomy	49 (23.4%)
	Gastrectomy (partial or total)	6 (2.9%)
	Omentum	163 (78.0%)
	Gallbladder	53 (25.4%)
	Spleen	38 (18.2%)
	Others*	14 (6.7%)
	Left upper quadrant/Right upper quadrant peritonectomy	60 (28.7%)
	Pelvic peritonectomy	70 (33.5%)
	Stoma	25 (12.0%)
Number of Anastomoses	0	66(31.6%)
	1	118 (56.5%)
	>1	25 (12%)

PCI: peritoneal carcinomatosis index; HIPEC: hyperthermic intraperitoneal chemotherapy; CC score: Completeness of cytoreduction score; ASA: American Society of Anesthesiology

*Cystectomy, pancreatic resection, psoas resection, bypass, duodenal resection, nephrectomy, ureteric resection.

Table 2. Univariate and Multivariate linear regression analysis evaluating factors associated with overall survival

Characteristic	Univariate Beta	P value	Multivariate Beta	P value
Gender	-0.061	.383		NS
Age	.128	.065	.034	.818
Length of Stay	.03	.669		NS
Signet cells	-.217	.003*	-.321	.051
CEA	.067	.439	.032	NS
Ca125	-.202	.059	-.097	NS
Ca19.9	-.117	.247		NS
PCI (continuous variable)	.136	.05*	.391	.04**
ASA	.141	.042*	.105	.446
Cytoreduction	.067	.337	-.371	.028**
Use of HIPEC	.054	.434		NS
Blood transfusion	-.004	.953		NS

CEA: Carcinoembryonic antigen; PCI: peritoneal carcinomatosis index; ASA: American society of Anesthesiology; HIPEC: hyperthermic intraperitoneal chemotherapy

* Significant on univariate analysis

** Significant on multivariate analysis

Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:

Narasimhan, V;Pham, T;Warrier, S;Lynch, AC;Michael, M;Tie, J;Ramsay, R;Heriot, A

Title:

Outcomes from cytoreduction and hyperthermic intraperitoneal chemotherapy for appendiceal epithelial neoplasms

Date:

2019-09-01

Citation:

Narasimhan, V., Pham, T., Warrier, S., Lynch, A. C., Michael, M., Tie, J., Ramsay, R. & Heriot, A. (2019). Outcomes from cytoreduction and hyperthermic intraperitoneal chemotherapy for appendiceal epithelial neoplasms. ANZ JOURNAL OF SURGERY, 89 (9), pp.1035-1040. <https://doi.org/10.1111/ans.14985>.

Persistent Link:

<http://hdl.handle.net/11343/285369>