Gynecologic Oncology Reports 55 (2024) 101488

Contents lists available at ScienceDirect

Gynecologic Oncology Reports

journal homepage: www.elsevier.com/locate/gynor

Pseudomyxoma peritonei arising from mature ovarian teratoma, a rare entity: Report of six cases and review of current literature

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ARTICLE INFO

Keywords:
Pseudomyxoma Peritonei
Mature ovarian teratoma
Cytoreductive surgery

ABSTRACT

Background: Pseudomyxoma peritonei (PMP) is a clinical syndrome characterised by intraperitoneal accumulation of mucus due to mucinous neoplasia. It is a rare condition affecting 1–2 per million individuals per year. The majority of PMP arises from a ruptured mucinous appendiceal tumour, with infrequent occurrences from other primary gastrointestinal tumours and mucinous ovarian tumours. PMP arising from a mature ovarian teratoma is a rare entity, with limited case reports in the literature. Given the infrequent and sporadic occurrences of these tumours, little is known about the tumour behaviour and prognosis.

Case series and literature review: Herein, we report six cases of PMP arising from a mature ovarian teratoma who were treated with primary cytoreductive surgery (CRS), with one case of recurrence. Literature review identified 21 cases from 12 manuscripts. Nineteen patients were treated with CRS alone, with two patients receiving adjuvant hyperthermic intraperitoneal chemotherapy (HIPEC). Follow up data were variably reported, with no recurrence in 20 patients during their follow up of 5–54 months. One patient reported to have died of disease at 49 months.

Conclusion: Despite the lack of high-quality evidence and limitations of small case series, our review indicates that close surveillance after CRS could be considered as the preferred treatment over more morbid CRS and HIPEC, with HIPEC reserved for patients who recur or progress after CRS.

1. Introduction

Pseudomyxoma peritonei (PMP) is a clinicopathologic syndrome characterised by intraperitoneal accumulation of mucus due to mucinous neoplasia, characterised by redistribution phenomenon, defined as redistribution of mucin and tumour cells, following the normal flow of peritoneal fluid within the abdominal cavity (Carr et al., 2016; Carr et al., 2017). It is a rare condition affecting 1–2 per million individuals per year. Due to the relative absence of symptoms in the early phases of the disease, patients often present in advanced stages with large amount of intra-abdominal mucinous ascites leading to abdominal distension, pain, changes in bowel/bladder function, malnutrition and over time, this may result in intestinal obstructions and death.

The majority of PMP arises from a ruptured mucinous tumour of the appendix, with infrequent occurrences of metastases from colorectal, urachial, gastric, pancreatic and ovarian mucinous tumours (Agrawal et al., 2014; Sugarbaker et al., 2008).

There have been case reports of PMP arising from mature ovarian teratoma; however, little is known about the tumour behaviour and prognosis, given the infrequent and sporadic occurrence of these rare tumours. Herein, we report six cases of PMP arising from transformation of a mature ovarian teratoma, followed by review of current literature of this rare entity.

2. Summary of six cases identified at authors' institutions

Six cases of PMP arising from mature ovarian teratoma who have been treated at the authors' institutions are presented in Table 1.

Five patients were aged 40 and above, while one patient was 24 years old at presentation. Five out of six patients presented with subacute abdominal symptoms due to mass effect, such as abdominal pain, distension, early satiety and weight loss. Symptom duration ranged from six weeks to five months. One patient presented acutely with pain from

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https://doi.org/10.1016/j.gore.2024.101488
Received 16 July 2024; Received in revised form 14 August 2024; Accepted 17 August 2024
Available online 18 August 2024

cyst rupture. Five patients had unilateral ovarian mass on imaging, while one had bilateral masses. Size of the masses were variable, ranging from 7 cm to 30 cm (Fig. 1).

CA125 and CEA were elevated in four out of six patients, while two patients had normal tumour markers. All patients underwent staging laparotomy and cytoreduction, with one patient having fertility-preserving surgery with preservation of one ovary and uterus.

Low-grade appendiceal-like mucinous neoplasm (LAMN-like) arising in mature ovarian teratoma was the most common histological diagnosis, found in three patients. Mucinous borderline tumour, high-grade appendiceal-like mucinous neoplasm (HAMN-like) and low-grade mucinous carcinoma were found in each of the three remaining patients. The appendix was microscopically normal in all six cases. Immunohistochemistry (IHC) profile was available in five out of six patients, with positive CK20 and focally positive CK7 in all reported cases. CDX2 and SATB2 were positive in all reported cases (three cases for both). PAX8 was negative in all four reported cases. Fig. 2 shows an example of patterns of IHC stains in our patients. Details of the histopathology results and IHC profile are summarised in Table 2.

None of our six cases received adjuvant treatment for PMP after their initial surgery. One patient was diagnosed with synchronous breast cancer, for which they received surgery, adjuvant chemotherapy (carboplatin and paclitaxel) and hormonal treatment (letrozole).

Only one patient developed disease recurrence requiring further treatment during follow up. This patient had an abdomino-pelvic computed tomography (CT) six months after the initial cytoreductive surgery showing widespread re-accumulation of mucinous fluid. They became progressively more symptomatic by nine months, and proceeded with secondary cytoreductive surgery and HIPEC at 12 months. The other five patients have no evidence of disease recurrence with a range of follow up from 8-60 months.

3. Review of current literature

A systematic literature search was conducted on PubMed using the MeSH terms 'Pseudomyxoma Peritonei' and 'Teratoma'. This found 21 published articles. Of these, two were excluded as they were not written in English and five were excluded due to the origin of PMP being non-ovarian. One manuscript was a retrospective review of 225 PMP patients, of which four cases originated from ovarian teratoma, but whose individual details were not reported and were hence excluded. One article was excluded as it was not a primary presentation of PMP, but PMP diagnosed at recurrence. There were 25 cases of PMP arising from ovarian teratoma described in the remaining 12 articles (Balakrishnan et al., 2023; Ponzini et al., 2022; Csanyi-Bastien et al., 2021; Gohda et al., 2016; Choi et al., 2016; Hwang et al., 2009; McKenney et al., 2008; Mandal et al., 2008; Stewart et al., 2006; Marquette et al., 2006; Pranesh et al., 2005; Ronnett and Seidman, 2003). Four of these cases were excluded as there was no histological examination of the appendix, therefore a primary appendiceal tumour could not be excluded. Our six cases described earlier have been added to the review, making a total of 27 cases (Table 2), with an age distribution of 24 to 89 years and a median age of 45 years.

There were five histological diagnoses of the primary ovarian tumour arising from mature cystic teratoma; LAMN-like, HAMN-like, borderline mucinous neoplasm, mucinous adenocarcinoma and mucinous

Table 1
Key characteristics of patients treated at authors' institutions. USO: Unilateral salpingo-oophorectomy, BSO: Bilateral salpingo-oophorectomy, CC: completeness of cytoreduction, wk: weeks, mo: months, n.a: not available

Case	Age	Symptoms	Symptom duration	Radiological findings	Tumour markers	Surgery	CC	Adjuvant treatment	Recurrence
1	40	Abdominal pain and bloating	6 wk	26 cm multilocular mass with preoperative rupture	Elevated CA125, CEA. Normal CA19–9, AFP, LDH, hCG	Laparotomy, hysterectomy, USO, omentectomy, appendicectomy, washings	0	None	No recurrence (60 mo)
2	56	Abdominal distension	3 mo	30 cm complex pelvic mass with ascites	Normal CA125, CA19–9, CEA, AFP, LDH, hCG	Laparotomy, BSO, omental biopsy, appendicectomy, peritoneal biopsy	3	None for PMP Received carboplatin and paclitaxel for synchronous breast cancer	No recurrence (28 mo)
3	24	Abdominal discomfort, reflux, early satiety	3 mo	30 cm multilocular complex mass with ascites	Elevated CA125, CEA Normal CA19–9, AFP, LDH, hCG	Laparotomy, USO, cystectomy from contralateral ovary, peritonectomy, appendicectomy, infracolic omentectomy	0	None	No recurrence (24 mo)
4	56	Abdominal bloating, weight loss	5 mo	13 cm multilocular mass with ascites	Normal CA125, CEA	Laparotomy, hysterectomy, BSO, omentectomy, appendicectomy, peritonectomy	0	None	No recurrence (32 mo)
5	46	Abdominal pain, bloating, nausea, early satiety	n.a.	Bilateral complex masses, 7 cm and 19 cm	Elevated CA125, CEA, CA19–9	Laparotomy, BSO, omentectomy, cytoreduction	0	None after initial surgery Secondary cytoreduction and HIPEC at recurrence	Recurrence at 6 months salvaged with secondary cytoreduction and HIPEC
6	44	Abdominal pain, distension, altered bowel habit	2 mo	17 cm multiloculated cystic lesion	Elevated CA125, CEA Normal CA19–9 AFP, LDH, hCG	Laparotomy, hysterectomy, BSO, appendicectomy, omental biopsy	0	None	No recurrence (8 mo)

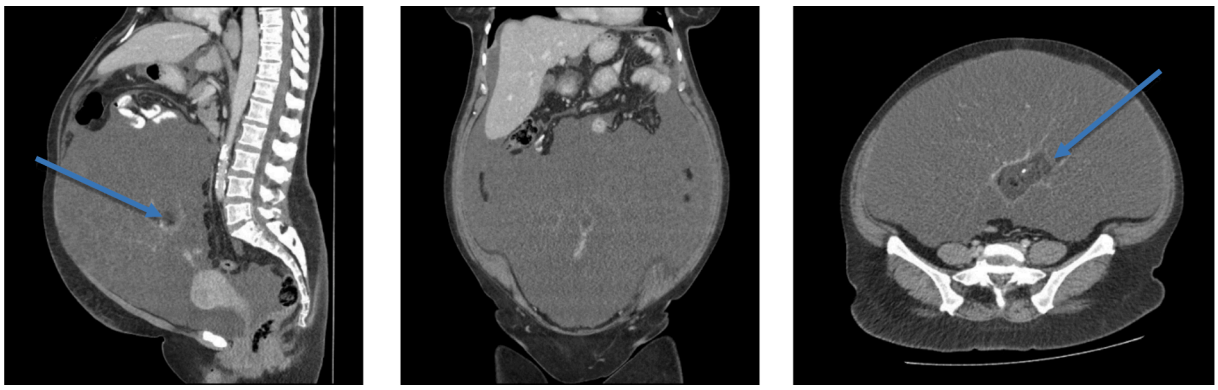

Fig. 1. Case 2: CT abdomen and pelvis showing 30 cm complex cystic lesion with fat centre and large volume ascites but no peritoneal or omental disease. Arrows indicating fat foci within the mass.

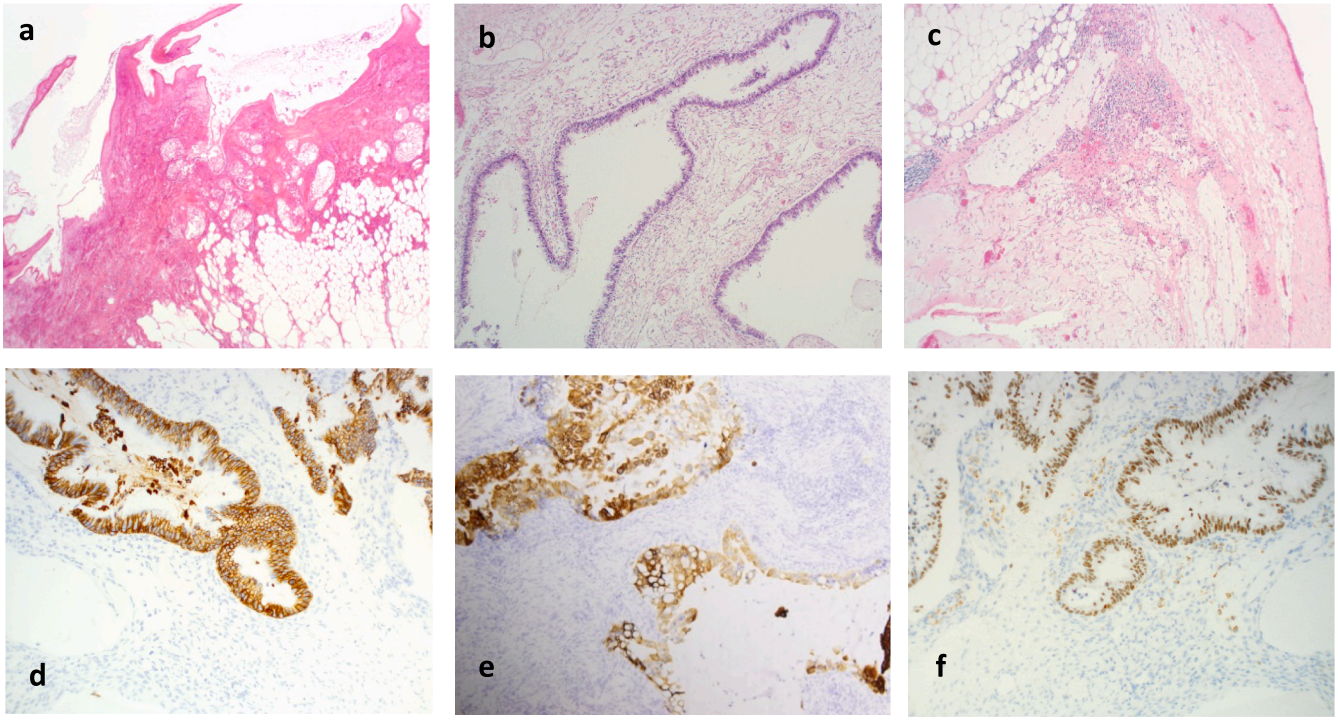

Fig. 2. **2a**: Necrotic mature teratoma (case 2). **2b:** High grade mucinous neoplasm (case 2). **2c:** Mucin omentum (case 2). **2d:** Positive staining for CK20 (case 2). **2e:** Patchy staining for CK7 (case 3) **2f:** Positive staining for SATB2 (case 2).

cystadenoma. Mucinous borderline neoplasm was the most common histological diagnosis made in 10 cases, followed by LAMN-like (seven), mucinous adenocarcinoma (six), and HAMN-like (one). There were three cases diagnosed as mucinous cystadenoma.

There was significant heterogeneity in how peritoneal disease was reported and classified in these 27 cases. Using the PSOGI classification of PMP (Carr et al., 2016), 18 out of 27 cases had acellular mucin, seven had low-grade mucinous carcinoma peritonei, two had high-grade mucinous carcinoma peritonei. There was no case of high-grade peritoneal mucinous carcinomatosis with signet ring cells.

An IHC profile with at least CK7 and CK20 was reported in 18 out of the 27 cases. All but one had CK7 negative/patchy and CK20 positive, consistent with classical GI profile. CDX2 and SATB2 stains were positive in all reported cases (eleven and four respectively).

In terms of treatment, all cases received primary CRS. Three of these patients had fertility sparing CRS. Only two patients had CRS and HIPEC as their primary treatment, which is in contrast to patients with PMP from appendiceal origin, for whom the standard treatment is combination of CRS and HIPEC (Sugarbaker, 2001; Chicago Consensus Working Group, 2020). Despite the retrospective nature of cases reviewed and limited follow-up (median of 24 months with a range between 2 and 61 months in 18 patients), there are only two patients who have been reported to have had a recurrence; one patient died 49 months after their initial treatment with CRS, and the other patient had secondary cytoreduction and HIPEC one year after primary CRS, with no evidence of recurrence eleven months after secondary cytoreduction.

4. Discussion

PMP, since its first description in 1884 by Werth *et al.*, has been the centre of much debate and controversy regarding its definition, classification and treatment (Bignell et al., 2016). With evolving knowledge of the biology, molecular genetics and clinical behaviour of PMP, multiple attempts have been made at defining and classifying this enigmatic disease.

Table 2
Literature review of 21 previously published cases and the addition of the 6 cases described in this paper. CRS: Cytoreductive surgery, LAMN: low-grade appendiceal-like mucinous neoplasm HAMN: High grade appendiceal-like mucinous neoplasm, HIPEC: hyperthermic intraperitoneal chemotherapy, mo: months, USO: Unilateral salpingo-oophorectomy, yr: years.

Author	Age	Histological diagnosis of ovarian tumour	Histology of peritoneal lesions	Appendix histology	IHC profile	Treatment received	Follow up data (time frame after treatment)
Balakrishnan et al., (2023)	53	LAMN-like ectopic mucinous neoplasm arising from ovarian mature cystic teratoma	Acellular Mucin	Normal	CK7-, CK20+, CDX2+, PAX8-	Incomplete CRS	No recurrence (5 mo)
Ponzini et al. (2022)	28	Ruptured LAMN-like neoplasm arising from an ovarian mature cystic teratoma	Low-grade mucinous carcinoma peritonei	Normal	CK7+ (focal), CK20+ (Strong), CDX2+ (Strong), SATB2 + Strong)	CRS+HIPEC	No recurrence (1 yr)
Csanyi-Bastien et al. (2021)	25	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Acellular mucin	Normal	CK7+ (heterogenous), CK20+, CDX2+	USO, omentectomy, appendicectomy (Fertility preserving treatment)	No recurrence (5 mo)
Gohda et al. (2016)	38	Right ovarian mature cystic teratoma accompanied by an endometriotic cyst Left ovarian mature cystic teratoma with moderately differentiated mucinous adenocarcinoma	Low-grade mucinous carcinoma peritonei	Normal	**In majority of cystic lesion:** CK7-, CK20+, (Diffuse), CDX2+ (Diffuse) **In region of moderately differentiated adenocarcinoma:** CK7+, CK20-, CDX2+	CRS+HIPEC	No recurrence (2 yr)
Choi et al. (2016)	45	Low-grade mucinous carcinoma arising from ovarian mature cystic teratoma	Acellular mucin	Normal	CK7-, CK20+, CDX2+	CRS	Not specified
Hwang et al., (2009)	46	Mucinous borderline neoplasm arising from ovarian mature cystic teratoma	Acellular mucin	Normal	CK7+ (Patchy), CK20+ (Diffuse), CDX2+ (Diffuse)	CRS	Not specified
McKenney et al. (2008)	57	Mucinous cystadenoma with ovarian mature cystic teratoma	Acellular mucin	Normal	CK7+ in 42 %, CK20+ in 77 %, CDX2+ in 65 %,	CRS	Not specified
	36	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Acellular mucin	Normal			Not specified
	54	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Acellular mucin	Normal			No recurrence (24 mo)
	42	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Low-grade mucinous carcinoma peritonei	Normal			Alive with unknown disease status (27 mo)
	47	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Low-grade mucinous carcinoma peritonei	Normal			No recurrence (23 mo)
	28	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Low-grade mucinous carcinoma peritonei	Normal			No recurrence (61 mo)
	56	Mucinous adenocarcinoma with squamous differentiation arising from ovarian mature cystic teratoma	Carcinomatosis	Normal			Not specified
Mandal et al. (2008)	45	Mucinous adenocarcinoma arising from ovarian mature cystic teratoma	Acellular mucin	Normal	Not specified	CRS	Not specified
Stewart et al. (2006)	38	Mucinous borderline tumour arising from ovarian mature cystic teratoma	Acellular mucin	Normal	CK7-, CK20+, CDX2+, CEA+,	CRS	No recurrence (24 mo)
	58	Mucinous borderline tumour arising from ovarian mature cystic teratoma Incidental stage IA grade 1 endometrioid	Acellular mucin	Normal	CK7-, CK20+, CDX2+, CEA+,	CRS	No recurrence (21 mo)

(*continued on next page*)

Table 2 (*continued*)

Author	Age	Histological diagnosis of ovarian tumour	Histology of peritoneal lesions	Appendix histology	IHC profile	Treatment received	Follow up data (time frame after treatment)
		adenocarcinoma of the endometrium					
Marquette et al. (2006)	67	Low-grade adenomatous mucinous tumour with borderline-like architecture arising from ovarian mature cystic teratoma	Acellular mucin	Previous appendicectomy	CK7-, CK20+ (strong)	CRS	No recurrence (6 mo)
Pranesh et al., (2005)	39	Mucinous cystadenoma arising from ovarian mature cystic teratoma	Acellular mucin	Normal	CK7-, CK20+, CEA+	CRS	No recurrence (9 mo)
Ronnett and Seidman (2003)	89	Mucinous borderline tumour arising from ovarian mature cystic teratoma	Low-grade mucinous carcinoma peritonei	Normal	CK7-, CK20+ (Diffuse)	CRS	No recurrence (48 mo)
	81	Mucinous cystadenoma arising from ovarian mature cystic teratoma	Acellular mucin	Normal	CK7-, CK20+ (Diffuse)	CRS	No recurrence (54 mo)
	35	Mucinous borderline tumour with focal adenocarcinoma arising from ovarian mature cystic teratoma	Low-grade mucinous carcinoma peritonei	Normal	CK7-, CK20+ (Diffuse)	CRS	Died of disease at 49 mo
Current article	40	Mucinous borderline tumour associated with ovarian mature cystic teratoma	Low-grade mucinous carcinoma peritonei	Normal	CK7+ (focal/weak), CK20+, CDX2+, PAX8-	CRS	No recurrence (60 mo)
	56	HAMN-like neoplasm arising in mature ovarian teratoma	Acellular mucin	Normal	CK7+ (focal), CK20+, CDX2+, SATB+, PAX8-	CRS+adjuvant chemotherapy (for concurrent breast CA)	No recurrence (28 mo)
	24	Low-grade mucinous carcinoma arising from a mature teratoma	Acellular mucin	Normal	CK7+ (patchy), CK20+, SATB+, PAX8-	CRS	No recurrence (24 mo)
	56	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Acellular Mucin	Normal	CK7+ (patchy), CK20+	CRS	No recurrence (32 mo)
	46	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Acellular Mucin	Normal	Not done	CRS	Symptomatic progression at 9 months, underwent CRS and HIPEC at 1 yr. No further recurrence (9 mo)
	44	LAMN-like neoplasm arising from ovarian mature cystic teratoma	Acellular mucin	Normal	CK7+ (focal) CK20+, CDX2+, SATB2+, PAX8-	CRS	No recurrence (8 mo)

Table 3
WHO classification and grading of PMP (Herrington, 2020). LAMN: low-grade appendiceal-like mucinous neoplasm, HAMN: High grade appendiceal-like mucinous neoplasm, PMP: Pseudomyxoma peritonei.

Peritoneal mucinous tumour grade	Acceptable terminology	Former terminology	Usual primary tumour	Histological criteria
Acellular mucin only (grade not applicable)			LAMN	Acellular mucin in the peritoneal cavity without identifiable mucinous epithelial cells
			Grade1 mucinous carcinoma of diverse sites	
PMP, grade 1	Mucinous carcinoma peritonei, grade 1	Disseminated peritoneal adenomucinosis	LAMN	Hypocellular mucinous deposits
			Grade1 mucinous carcinoma of diverse sites	Neoplastic epithelial elements composed of strips of low-grade mucinous epithelium
PMP, grade 2	Mucinous carcinoma peritonei, grade 2	Peritoneal mucinous carcinoma	HAMN	Hypercellular mucinous deposits as judged at 20x magnification
			Grade 2 mucinous adenocarcinoma of diverse sites	High-grade cytological features involving > 10% of the tumour
				Infiltrative-type invasion characterized by angulated glands in a desmoplastic stroma, complex glandular growth, or a pattern of numerous mucin pools containing clusters of tumour cells
PMP, grade 3	Mucinous carcinoma peritonei, grade 3		Signet-ring cell carcinoma of diverse sites	Mucinous tumour deposits with signet-ring cells or sheets of tumour cells
			Appendiceal goblet cell adenocarcinoma	

According to WHO Classification of Tumours – Female Genital Tumours, PMP is defined as deposits of mucinous tumours within the peritoneal cavity secondary to a mucin-producing epithelial neoplasm, usually of appendiceal origin (Herrington, 2020). Table 3 shows histological classification and grading of PMP.

On review of current literature, there is considerable variation in terminology used to describe PMP, reflecting the changes in classification system over the years. Historically, the terminology used for the ovarian lesions encountered in this setting has followed the benign, borderline or malignant categories used for other types of ovarian mucinous tumour. More recently, alternative terminology in the form of low-grade mucinous neoplasm, high-grade mucinous neoplasm, or adenocarcinoma, intestinal type arising in a teratoma has been suggested, in order to better align with the terminology used when the pseudomyxoma peritonei arises from an appendiceal lesion (Talia et al., 2022). All six cases reviewed in this series have been classified in this paper in accordance with this terminology.

5. PMP from mature ovarian teratoma

Mature ovarian teratoma is a common germ cell tumour of the ovary, and most cases are benign, with only 0.2–2% of cases undergoing malignant transformation (Yu et al., 2019). The most common malignancy arising from mature ovarian teratoma is squamous cell carcinoma (80%], with adenocarcinoma only making up 5% of all malignant transformation of mature ovarian teratoma (Ponzini et al., 2022; Mandal et al., 2008). PMP arising from transformation of a mature ovarian teratoma is exceedingly rare, with a reported incidence of 1–2/1,000,000 (Yan et al., 2020), as reflected in the small number of reported cases in the literature.

Given the rare incidence of PMP arising from mature ovarian teratoma, accurate diagnosis poses a challenge, requiring high clinical suspicion and evidence supporting an extra-appendiceal origin. Definitive diagnosis can only be confirmed with careful morphologic examination and IHC of the adnexal mass and a pathologic confirmation of a normal appendix (Carr et al., 2017). As shown in Table 2, IHC of most of the described cases in the literature show strong CK20 and CDX2 staining, with negative or focal CK7 staining. This is in support of the tumour having a GI phenotype and originating from appendiceal component of the teratoma. More novel IHC including SATB2 can be used to assist in the differentiation between primary ovarian mucinous and GI phenotypes (Strickland et al., 2016). SATB2 is a protein with largely restricted expression to glandular cells of the lower gastrointestinal tract, and is frequently detected in appendiceal mucinous neoplasms (Ponzini et al., 2022).

All six of our reported cases had histological confirmation of a normal appendix. The IHC profile in all reported patients was positive for CK20, CDX2 and SATB2, with focal or patchy CK7 staining, in support of our theory that the PMP originated from appendiceal-like lesion somatically derived within a teratoma through mucinous metaplasia, rather than another type of mucinous ovarian tumour.

6. Treatment considerations

Sugarbaker *et al.* introduced and popularised the idea of CRS and HIPEC for treatment of PMP, and these have now become the standard treatment for patients with PMP originating from appendiceal lesions (Sugarbaker, 2001; Chicago Consensus Working Group, 2020). In a multi-institutional registry of over two thousand patients who underwent CRS and HIPEC for PMP, patients had a median survival of 196 months, (16.3 years) and median progression-free survival of 98 months (8.2 years) (Chua et al., 2012). 10- and 15-year survival rates were 63% and 59%, respectively. Unsurprisingly, patients with low-grade mucinous carcinoma peritonei had a better outcome than patients with high grade mucinous carcinoma peritonei. Similarly, patients with less extensive disease based on PCI had a better outcome than those with more extensive disease. (Chua et al., 2012).

There is lack of evidence to guide the most appropriate treatments for PMP from extra-appendiceal neoplasms. Some have suggested that extra-appendiceal PMP should be treated with CRS and HIPEC similar to its appendiceal counterpart, given the absence of distinctive histological features pointing towards extra-appendiceal PMP as a local–regional disease (Baratti et al., 2016).

However, as demonstrated by our reported cases and other cases published in the literature, PMP arising from ovarian teratoma is often associated with acellular mucin only, with no carcinomatous cellular component beyond the ovary. It is difficult to ascertain whether these patients also benefit from such extensive treatment as is the standard for PMP of appendiceal origin (Pranesh et al., 2005). It is possible that CRS and HIPEC may be overtreatment for PMP arising from ovarian teratoma, especially given the high operative and postoperative morbidity associated with these treatments.

Others have suggested that tailored treatment based on histology of peritoneal disease may be appropriate. It may be appropriate for patients with acellular or low-grade mucinous carcinoma peritonei to have optimal surgical debulking with long term clinical follow up, while patients with invasive mucinous adenocarcinoma should be considered for adjuvant therapy, especially when there is confirmed metastasis beyond the confines of the primary tumour (McKenney et al., 2008).

7. Conclusion

PMP arising from ovarian teratoma remains a rare entity with limited case reports in the literature. The IHC profile of the primary ovarian tumour appears to closely mimic that of primary appendiceal neoplasms associated with PMP, which could justify treatment with aggressive CRS and HIPEC, similar to its classic appendiceal counterpart. However, all but one case we report on, as well as the majority of previously published cases, are associated with acellular mucin in peritoneal cavity, with no neoplastic cells seen beyond the ovarian tumour. Only two out of the 27 described cases (7.7%) recurred, with one case salvaged with CRS and HIPEC after a period of close surveillance.

To our knowledge, this series and literature review is the largest published on this rare entity. Despite the lack of high-quality evidence and limitations of small case series with limited follow-up, our review indicates that close surveillance after CRS could be considered as the preferred treatment over highly morbid CRS and HIPEC, with HIPEC reserved for patients who recur or progress. More research is required in this rare condition, with specific focus on treatment modalities and long term follow up outcomes thereafter.

8. Declaration

This manuscript was presented as a poster presentation at European Society of Gynaecology Oncology Annual Scientific Meeting in 2022 (case 2 and 3 only) and at Australian Society of Gynaecology Oncology Annual Scientific Meeting in 2023 (case 1, 2 and 3 only).

CRediT authorship contribution statement

Minah Ha: Writing – review & editing, Writing – original draft, Resources, Project administration. **Amy Jamieson:** Writing – review & editing, Writing – original draft, Resources. **Justine Pickett:** Writing – review & editing, Validation, Investigation. **Justin M. McGinnis:** Writing – review & editing, Resources. **Tom De Greve:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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