Histopathology 2001, **39**, 525–528

Pedunculated peritoneal surface polyps in pseudomyxoma peritonei syndrome

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Date of submission 19 February 2001
Accepted for publication 15 May 2001

Sugarbaker P H, Yan H & Shmookler B
(2001) *Histopathology* **39**, 525–528

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Aims: Pseudomyxoma peritonei syndrome is a rare disease that originates from an adenomatous lesion of the appendix that, from pressure, perforates to gain access to the free peritoneal cavity. The relative sparing of the small bowel surfaces allows for complete cytoreduction even though many kilograms of mucinous tumour exist at other sites within the abdomen and pelvis. The purpose of this study was to examine the mechanism whereby the small bowel remains free of gross tumour and peritoneal surface polyps form.
Methods and results: Peritoneal surface polyps were harvested and examined grossly and histologically. A hypothesis for their formation on small bowel and small bowel mesentery was proposed. Polyps are known to be associated with repeated motion of enteric contents moving past adenomatous tissue so that, over time, an elongated stalk is created. We have repeatedly observed pedunculated polyps on the peritoneal surface of the small bowel in patients with pseudomyxoma peritonei syndrome. No other site within the peritoneal cavity has had a pseudomyxoma polyp located upon its surface.
Conclusions: The peristaltic motion of the small bowel causes adherent adenomatous tissue to develop a stalk on the peritoneal surface. Motion not only creates polypoid lesions but also repeatedly clears mucinous tumour cells from the small bowel surface. With pseudomyxoma peritonei and with other types of cancerous dissemination, prevention of adherence by motion may interfere with the implantation of malignant cells.

Keywords: pseudomyxoma peritonei, adenomucinosis, adenomatous polyp, cytoreductive surgery, intraperitoneal chemotherapy, redistribution

Introduction

The pseudomyxoma peritonei syndrome has been extensively reviewed and its clinical features defined.[1] The disease has as its primary tumour an adenoma arising from the mucosa of the appendix.[2–4] The mucin-producing tumour cells gain access to the peritoneal cavity by penetrating the wall of the appendix. This usually occurs from a build up of internal pressure within the lumen of the appendix and an eventual rupture of this thin-walled structure. In some patients the primary appendiceal tumour has invasive capabilities and was shown to penetrate the appendiceal wall. After the adenomatous epithelial cells gain access to the free peritoneal cavity they cause a characteristic and predictable pattern of mucinous tumour progression.[5] Large masses of tumour accumulate by two mechanisms. First, peritoneal fluid resorption may draw tumour cells to distinct sites where they continue to proliferate. Peritoneal fluid movement to beneath the hemidiaphragms causes early accumulation of tumour between the liver and undersurface of the right hemidiaphragm. The lymphatic lacunae within the undersurface of the diaphragm accomplish this movement of fluid and of accompanying mucinous tumour cells.[6] Similarly, the milky spots within the greater and lesser omentum draw fluid to their surface and cause the 'omental cake' of mucinous tumour to form.[7] Another mechanism for

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early tumour accumulation is the force of gravity. Dependent sites such as the pelvis and right retrohepatic space are consistently observed to be layered by mucinous tumour. As the syndrome progresses all three of these sites continue to show the preponderance of mucinous tumour and mucinous ascites.

A crucial clinical observation concerns the sparing of small bowel surfaces by this disease process. Peritonectomy can be used to clear mucinous tumour from parietal peritoneal surfaces and from resectable visceral peritoneal surfaces such as portions of the large bowel or stomach. Surgical technology whereby small bowel can be stripped of its peritoneum does not exist. Neither can small bowel be extensively sacrificed. Minimal mucinous tumour accumulation on the peritoneal surface of the small bowel and its mesentery in pseudomyxoma peritonei syndrome is essential for successful treatment. The purpose of this report is to describe the peritoneal surface polyp in pseudomyxoma peritonei syndrome. Peristaltic motion of the small bowel is suggested as the mechanism for polyp formation and for small bowel sparing.

Materials and methods

The gross morphology and histopathology of pseudomyxoma peritonei have been studied in 515 patients.[3–5] A consistent finding by visual inspection of the peritoneal surface is the pedunculated polyp. The gross and microscopic observations concerning the pedunculated pseudomyxoma peritonei polyp are presented in this report.

Results

The pedunculated pseudomyxoma peritonei polyp was observed only in patients whose tumour histopathology showed adenomucinosis. The more aggressive histology, adenomucinosis/mucinous adenocarcinoma hybrid, rarely showed this lesion; if polyps were present with the more aggressive disease the polyp stalk was short or usually absent. Patients with mucinous adenocarcinoma did not have pedunculated lesions present.

The pedunculated pseudomyxoma polyp was observed only on small bowel surfaces and small bowel mesentery. Occasionally wisps of adenomucinosis accumulated in formations resembling polyps on the anterior surface of the body of the stomach; the polyp-like lesions were pedunculated but flattened, presumably because this structure was pressed against the undersurface of the left lateral segments of the liver. No polyps have been observed on large bowel, large bowel mesentery or parietal peritoneal surfaces. The most common site for the location of pseudomyxoma peritonei polyps was the small bowel mesentery. In a majority of patients multiple polypoid lesions were present on the small bowel mesentery. Usually, the small bowel peritoneal surface was totally free of adenomucinosis; when tumour was present it had a polypoid appearance as shown in Figure 1.

The pedunculated pseudomyxoma peritonei polyps were of all different sizes. The smallest lesions were accumulations of tumour cells and mucus debris on a tiny vascular pedicle. The large lesions were up to 20 mm in diameter on a well-organized stalk. The stalk was vascularized by visual inspection; also, if the polyps were bluntly removed there was always bleeding from the severed base of the stalk. Not only did the size of the head of the polyp vary greatly but the length of the stalk was inconsistent.

In two portions of the small bowel and small bowel mesentery no polyps were observed. The terminal ileum and the proximal jejunum were never anatomic sites for pseudomyxoma peritonei polyps. These anatomic sites were consistently involved by adenomucinosis but never contained pedunculated pseudomyxoma peritonei polyps.

By gross inspection the pedunculated pseudomyxoma peritonei polyp contains a head, stalk and base. This configuration is highly reminiscent of pedunculated adenomatous polyps that are seen within the bowel lumen. By histological study the head of the polyp contained pools of acellular mucin associated with blunt fibrous trabeculae. Within the mucin pools were lymphoplasmacytic aggregates. A few adenomatous epithelial cells were identified by repeated searching (Figure 2). Their presence was appreciated more readily by immunocytochemical study CAM 5.2

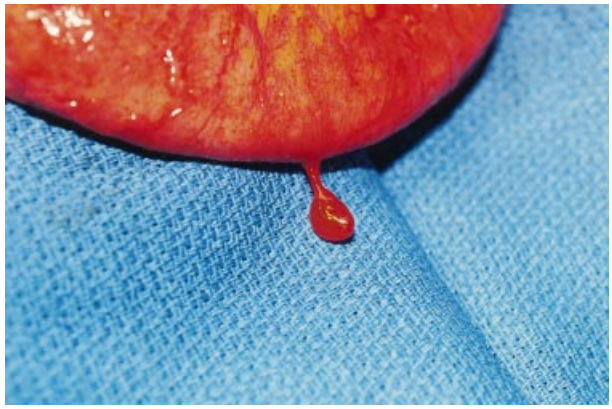

Figure 1. Gross appearance of the pedunculated pseudomyxoma peritonei polyp.

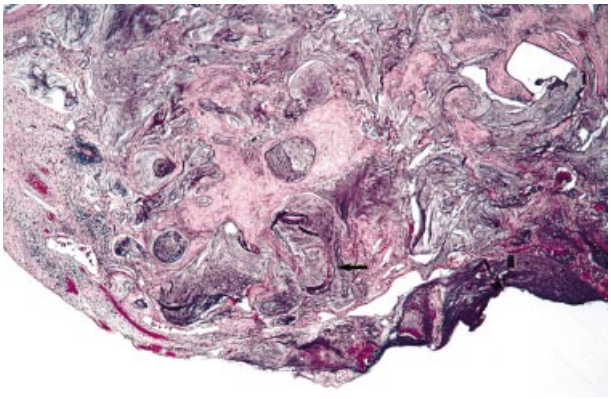

Figure 2. Microscopic appearance of the pedunculated pseudomyxoma peritonei polyp. The polypoid lesion contains pools of mucin associated with blunt fibrous trabeculae. The arrow indicates a strip of mucinous epithelium with minimal cytologic atypia. Inflammatory cells and a few capillaries are present. (H&E.)

(Figure 3). Mucinous epithelium within the polyp was also positive for AE1/AE3. The surface was devoid of an epithelial layer but mesothelial cells presented in some polyps.

Although a complete survey of our total experience is not possible retrospectively, the occurrence of polyps was tabulated for the year 2000. There were 52 new patients undergoing cytoreductive surgery plus intraperitoneal chemotherapy in 2000. Thirty of these showed diffuse peritoneal adenomucinosis as a histological type. Twelve of these patients (43%) had well-defined polypoid structures on some portion of the small bowel. There were 10 patients with the hybrid histology (occasional signet-ring cells) and none of these patients was recorded as having polypoid or small bowel mesentery surface lesions. Twelve patients had peritoneal mucinous carcinoma. No patients with carcinoma showed a pedunculated lesion.

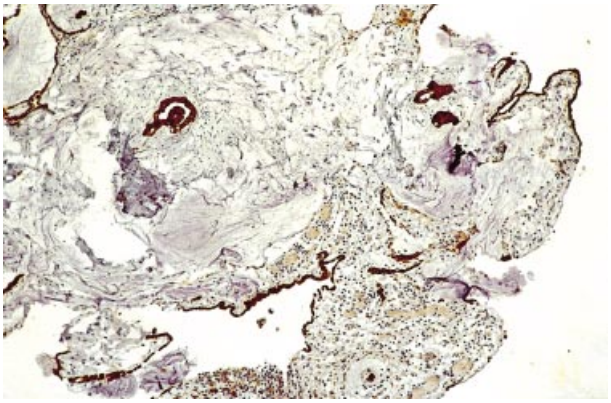

Figure 3. Immunohistochemical staining for CAM 5.2. Both the mucinous epithelium within the polyp and the mesothelial cells at the surface of the polyp show positivity for CAM 5.2. The polyp stalk shows many capillaries. (CAM 5.2.)

Discussion

The motion hypothesis may provide the mechanism whereby polyps form within the lumen of the bowel on the mucosal surface and also on its exterior on the peritoneal surface. As a slowly enlarging tumour nodule appears on an otherwise smooth mucosal surface, enteric material advances the nodule so as to place traction on the mucosa at the base of the nodule. If the enteric material can cause considerable motion of the nodule, over time a polyp will result. Similarly an implant of adenomucinosis on the otherwise smooth peritoneal surface of the small bowel would usually be displaced by friction resulting from the peristaltic activity of surrounding loops of small bowel. If a slowly growing adenomatous implant does occur, it is subjected to traction by the adjacent surfaces and a polyp may result. By the motion hypothesis the mechanism whereby an adenomatous tumour nodule within the colonic lumen becomes a polyp and the mechanism whereby an implant from an appendiceal adenoma becomes a polyp are the same.

The terminal ileum and the most proximal jejunum are areas on the small bowel where extensive accumulations of adenomucinosis are routinely observed. In a majority of patients with pseudomyxoma peritonei syndrome these are the only sites of large volume disease associated with the small bowel surfaces. These two small bowel sites are anatomically widely separated. However, they are similar in that they are tethered by attachments to the retroperitoneum. They would not have the mobility to move within the peritoneal space as the remainder of the small bowel and neither would the adjacent bowel segments frequently rub against their peritoneal surfaces. These two anatomic sites on the small bowel would be expected to accumulate adenomucinosis similar to other quiescent peritoneal surfaces but not contribute to the formation of pseudomyxoma peritonei polyps. These observations that small bowel tethered to the retroperitoneum does not develop pedunculated pseudomyxoma peritonei polyps and does not accumulate large amounts of adenomucinosis support the motion hypothesis for polyp formation and mucinous tumour redistribution.

There is no doubt that pseudomyxoma peritonei is a rare disease with only 300 new cases each year in the USA.[1] However, there may be some important lessons in tumour biology from a study of this rare disease.

Tumour cell adherence is a necessary prerequisite of cancer progression at any anatomic site. If motion prevents adherence then no metastases will develop. Metastases to skeletal and heart muscle are extremely unusual, presumably because cancer cells cannot adhere and then implant and grow on the endothelial surfaces of these tissues. Rather, metastases occur at static sites such as bone marrow, liver and lung. The motion hypothesis may be more broadly applicable than in the implantation of mucinous tumour cells on peritoneal surfaces.

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