Evidence for colorectal sarcomatoid carcinoma arising from tubulovillous adenoma

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Abstract

Sarcomatoid carcinomas of the colorectum are rare tumors that display both malignant epithelial and stromal components. Clinically, they are aggressive tumors with early metastasis. Due to their infrequent occurrence, the pathogenesis is poorly understood. We report a case of a 52-year-old woman who presented with a rectal mass and intermittent hematochezia. Superficial biopsies during colonoscopy revealed a tubulovillous adenoma with high-grade dysplasia. Endoscopic ultrasonography confirmed an invasive nature of the mass, and deeper biopsies revealed the presence of neoplasm with mixed histological components. The surgically-excised specimen demonstrated the presence of poorly differentiated spindle cells underneath the tubulovillous adenoma and an intermediate stage of invasive adenocarcinoma. Based on the histological appearance and immunohistochemical studies, a diagnosis of sarcomatoid carcinoma was made. Only nine cases of sarcomatoid carcinomas of the colorectum have been reported to date. As a result, the terminology and pathogenesis of sarcomatoid carcinoma remain speculative. To the best of our knowledge, this is the first report of co-existence of sarcomatoid carcinoma and invasive adenocarcinoma with tubulovillous adenoma; all stages represented within the same tumor. This observation supports the "monoclonal theory" of pathogenesis with an adenoma-sarcoma progression with or without an intermediate stage of carcinoma.

INTRODUCTION

Sarcomatoid carcinoma is a rare malignant tumor characterized by a combination of epithelial and mesenchymal elements. Over the past 100 years, sarcomatoid carcinomas have been increasingly recognized at different anatomical locations including the head and neck, respiratory tract, and female reproductive organs[1-3]. As a result, the natural history, pathogenesis, and treatment of these unusual tumors are poorly understood. In general, sarcomatoid carcinoma of the colon has been described as an aggressive neoplasm with an associated poor prognosis.

First described by Virchow in 1864, a variety of terms
have been used to describe sarcomatoid carcinomas. They include carcinosarcoma, pseudosarcomatous carcinoma, carcinoma with mesenchymal stroma, and spindle cell carcinoma[13]. These varied terminologies for sarcomatoid carcinomas reflect the uncertainty of its histogenesis and classification. Several theories have been proposed to explain the histopathogenesis of sarcomatoid carcinoma; however, these theories remain speculative.

We report an unusual case of a mixed rectal tumor containing a superficial tubulovillous adenoma with deeper areas of high-grade malignant spindle cells and an invasive adenocarcinoma; all stages represented within the same tumor. This could support an adenoma-to-sarcomatoid progression either directly or indirectly via an intermediate stage of adenocarcinoma. In addition, we discuss the basis of pathologic diagnosis, proposed theories regarding its histopathogenesis and review the clinical features of this heterogenous tumor.

**CASE REPORT**

A 52-year-old white female presented to the emergency department with a prolapsed rectal mass and intermittent rectal bleeding over the past 10 years. Until presentation, she had attributed her symptoms to hemorrhoidal disease and had performed digital reduction of the prolapsed ‘mass’ from time to time. Increased bleeding and frequency of prolapse made her seek medical attention. Her past medical history was unremarkable; however, there was a family history of colon cancer in her father. Physical examination revealed a large, firm, ulcerated mass that prolapsed from her rectum. Serum levels of carcinoembryonic antigen (CEA) and carbohydrate antigen (CA) 19-9 were not elevated. Colonoscopy confirmed the presence of a large sessile exophytic rectal growth with a velvety, multi-lobulated surface, just proximal to the dentate line (Figure 1A and B). Several biopsies were performed using a jumbo forceps, which revealed a tubulovillous adenoma with high-grade dysplasia. However, the possibility of an adjacent invading tumor beneath the tubulovillous adenoma could not be ruled out given the lack of depth from the biopsy. An extensive staging workup including a CT scan of the chest and abdomen showed no evidence of distant metastasis. To further evaluate the tumor for any presence and extent of local invasion, a rectal endoscopic ultrasound (EUS) was performed. At EUS, the invasive nature of the mass became apparent as the tumor invaded into the lamina propria and into the muscularis mucosa (Figure 1C, star). Additionally, an 8-mm hypoechoic lymph node seen on EUS. Based on the histological appearance and immunochemical studies, a diagnosis of sarcomatoid carcinoma was made. The disease was clinically staged according to the American Joint Committee on Cancer as a Stage I (T1N0M0) colorectal cancer. The patient’s postoperative course was uneventful and she remains free of tumor recurrence or metastasis after an 8-mo follow up.

**Case tissue**

Tissue from the rectal tumor was fixed in 10% neutral buffered formalin, embedded in paraffin wax, sectioned at 4 μm in thickness, floated onto positively charged slides, and dried overnight at 70°C. From each block, 5 micron thick sections were cut and stained with haematoxylin and eosin (HE). For immunohistochemical analysis, the avidin-biotin complex method was used with the following antibodies: pancytokeratin (Figure 3D), vimentin (Figure 3E), smooth muscle actin (SMA), S100, Bcl-2, CD34, smooth muscle myosin (SMMS), p53 (Figure 4A), CD117 (Figure 4B), desmin, and PDGFR-alpha

**Figure 1** Colonoscopy demonstrates. A: Large sessile polypoid growth with velvety surface and superficial ulceration in the rectum (forward view); B: Multilobulated, smooth surfaced exophytic nature of the tumor upon retroflexion. Sonographic images at rectal EUS showing; C: An infiltrative mass with invasion of the muscularis mucosa (star); D: An 8-mm hypoechoic lymph node suspicious for lymphatic metastasis (arrow).
The immunohistochemical profile is listed in Table 1. Appropriate positive and negative control tissues were incubated in parallel with the case slides to confirm the specificity of each antibody.

**Gross findings**

The surgical specimen consisted of a sigmoid and rectal segment measuring about 36.5 cm in length with a luminal diameter varying from about 4.8 cm at the proximal end to 8.0 cm at the distal end (Figure 3A and B). Located at the distal end of the specimen was an exophytic, circumferential, and fungating mass measuring about 5.5 cm in length along the gastrointestinal tract, rising approximately 1.3 cm from the luminal surface, with a greatest diameter of 6.2 cm. Just distal to the fungating mass was a squamous anal mucosa measuring about 0.8 cm in length. The remainder of the colonic mucosa was covered by small papules, which were slightly whiter than the gray mucosal background and measured about 0.1-0.3 cm in greatest dimension. These papules covered about 80% of the total surface of the colon and were most prominent in the distal area near the fungating mass. No ulcers or strictures were noted. Forty-one lymph nodes were isolated from the adipose tissue surrounding the bowel wall and were negative for any evidence of metastasis.

**Histological findings**

The initial superficial biopsies from the large rectal mass showed a tubulovillous adenoma with high-grade dysplasia; however, the possibility of adjacent invasive tumor could not be ruled out given the lack of depth from the

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**Table 1 Antibodies used for histological evaluation of the tumor, and a summary of the results**

| Antibody                        | Concentration | Company             | Result         |
|---------------------------------|---------------|---------------------|----------------|
| Smooth muscle actin (SMA)       | 1:2           | Dako                | Negative       |
| S100                            | 1:1000        | Zymed               | Negative       |
| Bcl-2                            | 1:60          | Dako                | Negative       |
| CD34                            | 1:30          | Becton Dickinson    | Negative       |
| PDGFα-α                         | 1:120         | Santa Cruz Biotechnology | Non-contributory |
| Smooth muscle myosin (SMMs)    | 1:100         | Dako                | Negative       |
| CD117                           | 1:150         | Dako                | Negative       |
| Desmin                          | 1:100         | Dako                | Negative       |
| Vimentin                        | 1:100         | Dako                | Negative       |
| p53                             | 1:100         | Dako                | Positive       |
| Pancytokeratin                  | 1:100         | Zymed AE1/AE3 Becton Dickinson Cam 5.2 | Patchy positive |

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(Figure 4C). The immunohistochemical profile is listed in Table 1. Appropriate positive and negative control tissues were incubated in parallel with the case slides to confirm the specificity of each antibody.

**Figure 2** Histology of the rectal biopsy using HE stains. A: Tubulovillous adenoma and underlying spindle cell tumor. The aggressive spindle cell lesion infiltrates directly underneath the adenoma (x 10); B: A higher magnification view of the adenomatous component (x 20). High-grade spindle cell lesion (x 40) showing: C: Cigar shaped nuclei, nuclear pleomorphism, a high mitotic rate; D: Tumor necrosis; E: Smooth muscle-like spindle sheets of cells in the sarcomatoid component (x 40).

**Figure 3** Gross appearance of the surgically-removed rectosigmoid mass (A and B). A: The luminal side view demonstrates the proximity to the dentate line; anal skin is labeled for orientation; B: Upon sectioning the sample through the sagittal plane, the lateral view identifies the sarcomatoid smooth component (marked as S) underneath the velvety tubulovillous adenoma component (marked as TVA); C: Invasive adenocarcinoma with high nucleus/cytoplasm ratio within the deeper sections; D: Pancytokeratin was diffusely positive in both epithelial and mesenchymal components (x 20); E: Vimentin showed expression in the sarcomatous (S) component only, with no staining in the carcinoma (C) portion.
biopsies. Subsequently, a larger piece of tumor tissue, obtained during a EUS procedure, revealed a neoplasm with mixed histological components consisting of high-grade spindle cells and a tubulovillous adenoma (Figure 2). The high-grade spindle cell tumor showed cigar shaped nuclei, nuclear pleomorphism, a high mitotic rate, a high nucleus/cytoplasm ratio, and central necrosis (Figure 2C-E). The spindle cells appear to infiltrate from the deep aspect of the biopsy into the mucosa and surround the adenoma-tous glands in an aggressive fashion. The tubulovillous adenoma, similar to the previous biopsy, contained abundant dysplastic epithelial glands with very few mucin.

The surgical specimen of the sigmoid colon and rectum revealed an invasive well-differentiated adenocarcinoma in a background of a large tubulovillous adenoma (Figure 3C). In addition, there was a focal sarcomatous component consisting of high-grade spindle cells. The carcinoma was composed of neoplastic epithelial cells, arranged in nests forming glandular structures with increased nuclear/cytoplasmic ratio and prominent nucleoli. The invasive carcinoma was confined to the submucosa (pT1) without gross or microscopic evidence of muscular invasion. Surgical margins were free of tumor and there was no evidence of metastasis in all 41 lymph nodes. According to the TNM classification, the pathological stage was pT1N0.

**Immunohistochemistry**

Immunohistochemical analysis revealed focal, but strong staining for pancytokeratin (Figure 3D), focal staining for vimentin (Figure 3E), smooth muscle actin, and patchy cell clusters of desmin in the spindle cell component of our specimen. Although staining for p53 revealed immunoreactivity in both the epithelial and sarcomatous components, it was relatively increased in the sarcomatous component (Figure 4A). In addition, the sarcomatous component was weakly positive for CD34 and Bcl-2, but negative for CD117 (Figure 4B). The epithelial component was diffusely immunoreactive to pancytokeratin and negative to smooth muscle actin, desmin, CD34, CD117, and Bcl-2. Since there is a subset of gastrointestinal stromal tumors that are negative for CD117 and positive for PDGFR-α, we performed an immunohistochemical staining for PDGFR-α, which stained diffusely positive in both the spindle and epithelial cells of the overlying tubulovillous adenoma (Figure 4C). Taken together, the strong cytokeratin staining and the focal positivity for smooth muscle markers, the tumor adjacent to the tubulovillous adenoma was diagnosed as sarcomatoid carcinoma rather than a carcinosarcoma or CD117-negative GIST.

**DISCUSSION**

Sarcomatoid carcinoma of the colon is a rare clinical and pathological entity. To the best of our knowledge, only nine cases of colonic sarcomatoid carcinoma have been reported in the English literature (Table 2), the present case being the tenth. Histologically, sarcomatoid carcino-

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Table 2  Summary of demographics and outcome of cases reported in the English literature with the diagnosis of colorectal sarcomatoid carcinoma

| Case | Author, yr | Age (yr) | Sex | Site          | Distant metastasis | Outcome          |
|------|------------|----------|-----|---------------|--------------------|------------------|
| 1    | Weidner, 1986 | 73       | M   | Sigmoid      | On follow up        | 4 yr, DOD        |
| 2    | Chetty, 1993  | 72       | F   | Cecum        | On initial visit    | 3 mo, DOD        |
| 3    | Roncaroli, 1995 | 71      | F   | Rectum       | On follow up        | 6 mo, DOD        |
| 4    | Isimbaldi, 1996 | 86      | F   | Ascending colon | None                | 2 yr, disease free |
| 5    | Shoji, 1998   | 78       | M   | Descending colon | None                | 16 mo, disease free |
| 6    | Takeyoshi, 2000 | 82      | M   | Rectum       | On follow up        | 6 mo, DOD        |
| 7    | Kim, 2001     | 41       | F   | Sigmoid      | On follow up        | 4 mo, DOD        |
| 8    | Di Virio, 2001 | 56      | F   | Descending colon | On follow up        | 21 mo, DOD        |
| 9    | Kim, 2005     | 71       | M   | Ascending colon | On initial visit    | Unspecified      |
| 10   | Present case  | 52       | F   | Rectum       | None                | 8 mo, disease free |

DOD: Died of disease.
nomas of the colon contain both epithelial and mesenchymal components. The epithelial component of these tumors mainly consists of high-grade adenocarcinoma, while the accompanying sarcomatous component often demonstrates a spindled appearance with varying degrees of mesenchymal-like differentiation.

The nomenclature of these bi-differentiated tumors has been a matter of debate despite the advent of immunohistochemistry and electron microscopy. In the past, the term pseudosarcoma was used to describe the condition in which the epithelial component was malignant and spindle cells were benign. Later, Matussaka et al. showed that pseudosarcoma and sarcomatoid carcinoma were histologically and clinically the same conditions. Moreover, several reports have used carcinosarcoma interchangeably to describe sarcomatoid carcinoma, further confusing the diagnosis and classification of these tumors. Rosai J explained that when the sarcomatous component is mainly composed of spindle cells but still identifiable as epithelial ones morphologically or immunohistochemically, the diagnosis should be called sarcomatoid carcinoma. However, when sarcomatous components reveal typical specialized differentiation such as obvious striation of rhabdomyosarcoma or osteoid produced by malignant neoplastic cells, the diagnosis should be called carcinosarcoma. For cases without any histologically-identifiable differentiation, immunostaining for cytokeratin or other epithelial markers may help in determining whether the neoplasm matches the qualifications for sarcomatoid carcinoma or carcinosarcoma. The common denominator of all sarcomatoid carcinomas is the immunoreactivity of epithelial markers such as cytokeratin for both the sarcomatous and epithelial components. However, if sarcomatous elements do not express epithelial markers, the term carcinosarcoma is the preferred diagnosis. In our case, both the sarcomatous and epithelial components were immunoreactive to pancytokeratin, confirming our diagnosis of sarcomatoid carcinoma.

The histogenesis of sarcomatoid carcinoma remains unclear and controversial despite more than a century of conjecture. Proposed explanations of the bi-differentiated appearance include the monoclonal hypothesis on one hand, and on the other hand the “collision theory”, suggesting that the two tumor components are derived from separate and distinct malignant cell clonal. Other investigators suggest a clonal origin (monoclonal hypothesis) of the tumor since common characteristics have been seen between the different cellular populations as well as an observed transitional population. For example, the presence of cytokeratin in spindle cells within sarcomatoid carcinomas of various anatomical locations supports the epithelial origin of these cells. The observed characteristics in the monoclonal hypothesis could either be due to a malignant transformation of a pluripotent stem cell capable of epithelial and mesenchymal differentiation or the sarcomatous element arising from a metastatic transformation of the carcinomatous element. Some postulate that this sarcomatous transition from carcinomatous cells could be related to retrovirus infection. Sarcomatoid carcinomas demonstrated very rarely to be “collision tumors” with sharply defined sarcomatous and carcinomatous components without any shared or transitional features. There is, however, strong molecular evidence that supports the monoclonal origin of most sarcomatoid carcinomas. Several genetic studies involving loss of heterozygosity (LOH) with microsatellite markers and pattern of X chromosome inactivation have demonstrated a common origin of the admixed components. In addition, Delahunt et al. described progressive accumulation of p53 proteins in the phenotypic conversion of carcinoma into sarcomatoid phenotype, thus indicating an increasing clonal dominance of dedifferentiated tumor cells carrying p53 mutations.

In our case, the surgically removed rectal tumor demonstrated both tubulovillous adenoma and adenocarcinoma adjacent to each other with sarcomatous elements right beneath the tubulovillous adenoma. This histological finding strongly suggests that the two components originated from a multipotent epithelial cell, and that the sarcomatous components originated with differentiation from adenoma to sarcomatoid phenotype during tumor progression through an intermediate stage of adenocarcinoma. To further support a monoclonal origin and a possible tumor progression sequence in our case, immunohistochemistry for p53 protein showed increasing accumulation of p53 from tubulovillous adenoma to adenocarcinoma and finally to the sarcomatous area (Figure 4A). The adenoma-to-carcinoma sequence is well known; however little is known whether the sarcomatous phenotype is part of this tumor progression sequence. To our knowledge, this is the first case that demonstrates a clear histological adenoma-adenocarcinoma-sarcomatoid phenotype sequence progression all in one image.

Clinical features of all ten cases (including our present report) showed a mean age of 68 years (range 41-86) and a slight predilection for females (Table 2). Sarcomatoid carcinomas can be located anywhere in the large bowel, but a preference for the distal colon (including the descending colon, sigmoid colon, and rectum) is seen in most cases. Lymph nodes and distant sites of metastasis disclose a predominance of the malignant epithelial component. However, only one case has shown metastasis from the sarcomatous element, indicating the aggressive nature of the epithelial component. Despite radical surgery, chemotherapy, or radiotherapy, prognosis for sarcomatoid carcinoma of the colon remains poor. Seven cases revealed distant metastasis either at initial or follow-up visit, and six of the ten cases died within five years of diagnosis. Due to the rarity of cases, no specific conclusions can be made regarding prognostic factors.

Treatment for sarcomatoid carcinomas of the colon should follow similar guidelines for colonic adenocarcinomas, as no specific treatment guidelines are available for the management of this tumor. In addition, extensive follow-up should be warranted given the poor prognosis associated with this rare clinical entity. Nine of the ten reported cases (including ours) of colonic sarcomatoid carcinomas have undergone resection of the primary tumor; however, only two of the ten cases have survived over the
past two years despite adjuvant therapy. In a recent 8-mo follow-up, our patient is still alive with no evidence of metastasis after surgical resection of the primary tumor.

In summary, sarcomatoid carcinoma of the colon is a highly aggressive neoplasm that leads to a poor patient outcome despite clinical intervention. Endoscopic biopsy specimens containing lesions with spindle cell morphology should raise the differential diagnosis of sarcomatoid carcinoma with immunostaining for cytokeratin to help confirm the diagnosis. The histogenesis of sarcomatoid carcinoma is still unclear; however, the morphological appearance and immunohistochemical analysis of our case strongly suggests an adenocarcinoma-sarcomatoid carcinoma sequence progression as the likely pathogenesis of this rare tumor. Clinical management should follow the diagnostic and therapeutic guidelines for colorectal adenocarcinomas given the paucity of cases. Further studies and collection of cases are needed to establish proper therapeutic interventions.

REFERENCES

1. Leventon GS, Evans HL. Sarcomatoid squamous cell carcinoma of the mucous membranes of the head and neck: a clinicopathologic study of 20 cases. Cancer 1981; 48: 994-1003

2. Zimmerman KG, Sobonya RE, Payne CM. Histochemical and ultrastructural features of an unusual pulmonary carcinosarcoma. Hum Pathol 1981; 12: 1046-1051

3. Norris HJ. Taylor HB. Mesenchymal tumors of the uterus. In: Rosai J, 9th ed. Rosai and Ackerman's Surgical Pathology. Vol. I. Edinburgh, UK: Mosby, 2004: 345-346

4. Tanimura H, Furuta M. Carcinosarcoma of the stomach. Am J Surg 1967; 113: 702-709

5. Minkler DS, Meligro CH, Norris HT. Carcinosarcoma of the larynx. Case report with metastases of epidermoid and sarcomatous elements. Cancer 1970; 26: 195-200

6. Kuhajda FP, Sun TF, Mendelsohn G. Polypoid squamous carcinoma of the esophagus. A case report with immunostaining for keratin. Am J Surg Pathol 1983; 7: 495-499

7. Takubo K, Tsuchiya S, Nakagawa H, Futatsuki K, Ishibashi I, Hirata F. Pseudosarcoma of the esophagus. Hum Pathol 1982; 13: 503-505

8. Weidner N, Zekan P. Carcinosarcoma of the colon. Report of a unique case with light and immunohistochemical studies. Cancer 1986; 58: 1126-1130

9. Chetty R, Bhathal PS. Caecal adenocarcinoma with rhabdoid phenotype: an immunohistochemical and ultrastructural analysis. Virchows Arch A Pathol Anat Histopathol 1993; 422: 179-182

10. Roncaroli F, Montironi R, Felicicci I, Aquilani M, Eusebi V. Sarcomatoid carcinoma of the anorectal junction with neuroendocrine and rhabdomyoblastic features. Am J Surg Pathol 1995; 19: 217-223

11. Isimbald G, Sironi M, Assis A. Sarcomatoid carcinoma of the colon. Report of the second case with immunohistochemical study. Pathol Res Pract 1996; 192: 483-487

12. Shoji M, Dobashi Y, Iwabuchi K, Kawanaka S, Miwami T, Kameya T. Sarcomatoid carcinoma of the descending colon—a histological, immunohistochemical and ultrastructural analysis. Acta Oncol 1998; 37: 765-768

13. Takeyoshi I, Yoshida M, Ohwada S, Yamada T, Yanagisawa A, Morishita Y. Skin metastasis from the spindle cell component in rectal carcinosarcoma. Hepatogastroenterology 2000; 47: 1611-1614

14. Kim JH, Moon WS, Kang MJ, Park MJ, Lee DG. Sarcomatoid carcinoma of the colon: a case report. J Korean Med Sci 2001; 16: 657-660

15. De Vizio D, Insaibato L, Conzo G, Zafonte BT, Ferrara G, Pettinato G. Sarcomatoid carcinoma of the colon: a case report with literature review. Tumori 2001; 87: 431-435

16. Kim N, Luchs JS, Halpern D, Davis E, Donovan V, Weston SR, Katz DS. Radiology-Pathology Conference: carcinosarcoma of the colon. Clin Imaging 2005; 29: 259-262

17. Lezione JC, Mills SE. Sarcomatoid carcinomas (carcinosarcomas) of the gastrointestinal tract: a review. Semin Diagn Pathol 1993; 10: 176-187

18. Wick MR, Swanson PE. Carcinosarcomas: current perspectives and an historical review of nosological concepts. Semin Diagn Pathol 1993; 10: 118-127

19. Ishida H, Ohsawa T, Nakada H, Hashimoto D, Okubu T, Adachi A, Itoyama S. Carcinosarcoma of the rectosigmoid colon: report of a case. Surg Today 2003; 33: 545-549

20. Matsusaka T, Watanabe H, Enjoji M. Pseudosarcoma and carcinosarcoma of the esophagus. Cancer 1976; 37: 1546-1555

21. Nakao A, Sakagami K, Uda M, Mitsuoka S, Ito H. Carcinosarcoma of the colon: report of a case and review of the literature. J Gastroenterol 1998; 33: 276-279

22. Rosai J. Gastrointestinal Tract. In: Rosai J, 9th ed. Rosai and Ackerman's Surgical Pathology. Vol. I. Edinburgh, UK: Mosby, 2004: 345-346

23. Aramendi T, Fernandez-Acenero MJ, Villanueva MC. Carcinosarcoma of the colon: report of a rare tumor. Pathol Pract 2003; 199: 345-348

24. Huszar M, Herczeg E, Lieberman Y, Geiger B. Distinctive immunofluorescent labeling of epithelial and mesenchymal elements of carcinosarcoma with antibodies specific for different intermediate filaments. Hum Pathol 1984; 15: 552-558

25. Steeper TA, Piscioli F, Rosai J. Squamous cell carcinoma with sarcoma-like stroma of the female genital tract. Clinico-pathologic study of four cases. Cancer 1983; 52: 890-898

26. Wick MR, Perrone TL, Burke BA. Sarcomatoid transitional cell carcinomas of the renal pelvis. An ultrastructural and immunohistochemical study. Arch Pathol Lab Med 1985; 109: 55-58

27. Al-Nafussi A, Wong NA. Intra-abdominal spindle cell lesions: a review and practical aids to diagnosis. Histopathology 2001; 38: 387-402

28. Gal AA, Martin SE, Kemen K, Patterson MJ. Esophageal carcinoma with prominent spindle cells. Cancer 1987; 60: 2244-2250

29. Gentile R, Castellana A. [Carcinosarcoma of the colon, one or two tumors?] Pathologica 1997; 89: 62-68

30. Kashiwabara K, Sano T, Oyama T, Najahima T, Makita F, Hashimoto N, Iwanami K, Kawashima O, Matsumoto M, Matsuzaki Y, Akiyama K, Itoyama S. Carcinosarcoma of the colon: report of a case. Jpn J Surg 2001; 31: 423.e5-423.e8

31. Ray ME, Wjnio KJ, Goldstein NS, Olson KB, Shah RB, Cooney KA. Clonality of sarcomatous and carcinomatous elements in sarcomatoid carcinoma of the prostate. Urology 2006; 67: 425.e5-423.e8

32. Sung MT, Wang M, MacLennan GT, Eble JN, Tan PH, Lopez-Beltran A, Montironi R, Harris J, Kusugira T, Cheng HH. Histogenesis of sarcomatoid urothelial carcinoma of the urinary bladder: evidence for a common clonal origin with divergent differentiation. J Pathol 2007; 211: 420-430

33. Delahunt B, Eble JN, Nacey JN, Grebe SK. Sarcomatoid carcinoma of the prostate: progression from adenocarcinoma is associated with p53 over-expression. Anticancer Res 1999; 19: 4279-4283