Synchronous Rectal and Gastric Cancer in a Fighter Pilot: Aeromedical Concerns

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Abstract Synchronous cancer of the stomach and rectum is very rare. In a special population of pilots, especially fighter pilots, synchronous rectal and gastric cancer is much more uncommon. We herein report a case of synchronous carcinoma of the rectum and stomach. The patient was a 44-year-old male fighter pilot who complained with bloody stool and altered bowel habits. He was diagnosed with hereditary non-polyposis colorectal cancer with a definite family history, and subsequently he underwent simultaneous low anterior resection and distal gastrectomy with D2 lymphadenectomy. Postoperative pathologic assessment showed a poorly differentiated gastric adenocarcinoma with signet ring cell components (pT2N1M0; stage IIb) and a moderately differentiated rectal adenocarcinoma with myxoid components (pT3N0M0; stage IIa). Both tumors showed positive expression of p53, Ki-67, VEGF, carcinoembryonic antigen, MRP, TS, P-gp, and TopoII, and negative expression of c-erbB2, CD34, CD31, D2-40, S-100, FVIII, MLH1, MSH2, and MSH6 oncoproteins. Six cycles of XELOX chemotherapy and 50 Gy/25 f

radiotherapy were delivered postoperatively. Now, he has returned to his work under medical observation for about 6 months. From this patient's diagnosis and treatment, we think that the gene screening should be used in pilot selection. According to the result of gene screening, we can give pertinence examinations to the target organ of genes. It is very necessary for pilots to keep keen vigilance at gastrointestinal tumors because they have to face many high-risk factors in working. As to pilots, the selection of operation should be individualized.

Keywords Synchronous carcinoma · Hereditary disease · Colorectal cancer · Military personnel · Pilot selection

Introduction

Synchronous cancer of the stomach and rectum is very rare [1]. In a special crew population—pilots, especially fighter pilots, synchronous rectal and gastric cancer is much more uncommon. We herein report a fighter pilot case of synchronous carcinoma of the rectum and stomach.

Case Report

Case History The patient was a 44-year-old male fighter pilot who complained with bloody stool and altered bowel habits for about half month. Colonoscopy showed a 3×5-cm ulcerative lesion at the posterior wall of the rectum located about 8 cm from the anal verge, which was pathologically confirmed as a rectal adenocarcinoma with myxoid component by biopsy. Whole-body positron emission tomography–computed tomography (PET-CT) scan showed that the ¹⁸F-fluorodeoxyglucose density increased uptake not only in the rectum lesion

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but also in the gastric antrum with a standardized uptake value greater than 12.4. Then, he received gastroscopy examination that found a 2×3-cm ulcerative mass at the posterior wall of the gastric antrum near the lesser curvature. Biopsy demonstrated that the lesion was a gastric adenocarcinoma with signet ring cell component. Whole-body PET-CT and abdominothoracic CT demonstrated no significant distant metastatic lesions. Carcinoembryonic antigen (CEA) and carbohydrate antigen 19-9 were normal. The patient had a history of appendectomy and acute erosive gastritis, more than 20 years of smoking history, 10–20 cigarettes per day, and moderate drinking history. His mother underwent hysterectomy for endometrial cancer at the age of 60 and eventually died from rheumatism at the age of 63. His grandfather died from colon cancer at the age of 61 (Fig. 1). According to the Amsterdam II criteria [2], this patient was finally diagnosed with hereditary nonpolyposis colorectal cancer (HNPCC).

Therapy Procedure Various treatment strategies were discussed. Because the two lesions were all too large and extensive to perform laparoscopic surgery [3], the conventional open surgery was adopted through Kocher's incision and hypogastric paramedian incision, respectively (Fig. 2). Operation was performed under general anesthesia. Following the principle of aseptic technique, we firstly performed distal gastrectomy with D2 lymphadenectomy for gastric cancer and then performed low anterior resection for rectal cancer. Two operations were accomplished within 3 h, and the estimated blood loss was 200 mL. This patient's postoperative course was uneventful. He defecated on the third postoperative day and resumed liquid food on the fifth postoperative

Fig. 2 Placement of incisions and drainage tubes

day; the sutures were removed on the ninth postoperative day, and then he underwent six cycles of XELOX regimen and 50 Gy/25 f/5 w radiotherapy. He returned to work after medical observation for about 6 months and still keeps in follow-up now.

Pathological Findings Macroscopic examination of the distal gastrectomy identified an ulcerative lesion 2.5×2.0×1.0 cm in diameter located on the lesser curvature of the antrum (Fig. 3a). Microscopically, the tumor was a poorly differentiated adenocarcinoma with signet ring cell component (Fig. 3b); gastric muscular layer was infiltrated, without nerve and vascular invasion; and two of the 14 resected lymph nodes around the stomach were positive for metastasis (pT2, pN1; stage IIb). The rectal lesion which is 5.0×4.0×3.5 cm in size is located at the upper middle part of the rectum (Fig. 4a). Microscopic examination showed moderately differentiated rectal adenocarcinoma with myxoid component (Fig. 4b), penetrating the bowel wall, without nerve and vascular invasion; all the 17 resected lymph nodes had no tumor metastasis (pT3, pN0; stage IIa). In immunohistochemical examination, both tumors showed positive expression of p53, Ki-67, VEGF, CEA, MRP, TS, P-gp, and TopoII and negative expression of c-erbB2, CD34, CD31, D2-40, S-100, FVIII, MLH1, MSH2, and MSH6. The common losses of MLH1, MSH2, and MSH6 protein in both cancer tissues demonstrated that the dysfunction of DNA mismatch repair genes and proteins played an important role in the tumorigenesis of both tumors.

Discussion

Pilots, especially fighter pilots, embody the fighting power of the Air Force service. The clinical aeromedicine always focuses on how to enhance their fighting capacity [4], ignoring potential oncological concerns. Although this fighter pilot

Fig. 1 The patient's family tree

Fig. 3 The specimen of the gastric cancer. **a** Macroscopic (inner face). **b** Microscopic (H&E $\times 400$)

case of HNPCC with synchronous rectal and gastric cancer is very rare, we think we should learn something as follows.

First, our current system of pilot selection ignore the pilot's genetical background and hereditary diseases, extremely emphasizing the pilot's physical examination [5, 6], such as vestibular function, eyesight, cardiopulmonary function, electrophysiological study, and so on. The consequence is that some excellent pilots, who are meanwhile carriers of oncogenes, may become cancer patients after a few years. Such a situation not only causes a severe waste of social resource but also dramatically decreases the morale and battle effectiveness. Take HNPCC for instance. Its median onset age is around 44 years, and the next generation begins earlier about 10~20 years than the previous generation [7]. This age group is precisely golden age for fighter pilots in their career. So we think it is necessary to screen HNPCC-related genes in pilot selection and not only focus on physical examination.

Second, gene screening does not mean genetic discrimination [8]. After all, the pathogenic gene penetrances of HNPCC are not 100 %. For the aim of early detection and early treatment, we can select appropriate gene screening for some special cancers. Even without the screening of HNPCC-related genes, we think that it is still necessary for pilots to keep vigilance at gastrointestinal tumors. Because of career reasons, the fighter

pilots have to face many high-risk factors for gastrointestinal tumors [9, 10], such as high-protein and high-calorie diet, physical and psychological stress, radiation from airborne radar and energetic particles, de-stressing through smoking and alcohol, and so on. However until now, we judge digestive disorders only depending on fecal occult blood, in the routine examinations, while endoscopy is not a routine examination yet. The absence of endoscopy may delay the diagnosis and treatment of gastrointestinal tumors in pilots. In addition, there have been some advanced and painless techniques such as PET-CT. We think that it is available for pilots who undergo whole-body PET-CT every few years to detecting early-stage tumor [11].

Finally, what operation should be performed in HNPCC is still controversial [12]. Surgeons and patients should consider cancer risk in the remaining colon as well as functional consequences of removing the entire colorectum. However, we think that the selection of operation should be individualized. In this case, the pilot would thoroughly lose his ability to fly the fighter if he underwent gastrectomy and colectomy. In addition, HNPCC contains a series of tumors, such as renal pelvic and ureteral malignancy, small intestine cancer, colorectal cancer, and so on. He still has high risk to develop other HNPCC-related tumors even if his colorectum and stomach were excised.

Fig. 4 The specimen of the rectal cancer. **a** Macroscopic (longitudinal section). **b** Microscopic (H&E $\times 400$)

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Conflict of Interest None of the authors have a commercial or other financial interest associated with the information presented in this manuscript.

Ethical Approval The study protocol was approved in advance by the Air Force General Hospital, Chinese PLA. Each subject provided written informed consent before participating.

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We have obtained consent for publication in print and electronically of this case report from the patient.