Incidentally Detected Small Intestine Intussusception Caused by Primary Small Intestine Carcinoma on ^{18}F -FDG PET/CT

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Abstract Small intestine intussusception in adults is a rare condition mainly caused by primary or metastatic small intestine malignancy. Here, we present a 72-year-old male patient who was diagnosed with small intestine cancer that was presented as small intestine intussusception on hybrid ^{18}F -fluorodeoxyglucose positron emission tomography/computed tomography (FDG PET/CT). The patient was initially referred for an abnormality on a chest radiography and severe anemia. FDG PET/CT showed the lung lesion in the right upper lobe of lung as a high FDG uptake mass. Accidentally, FDG PET demonstrated another intense hypermetabolic intraluminal lesion in the small intestine accompanied with intussusception shown as a circumferential hypermetabolic wall. By pathologic examination, the patient was diagnosed as primary small intestine cancer with lung metastasis. This case highlights usefulness of hybrid FDG PET/CT to identify unexpected malignancy.

Keywords FDG PET/CT · Intussusception · Small intestine cancer · Undifferentiated carcinoma

Introduction

Intussusception is a condition in which a part of the intestine invaginates into adjacent section of intestine. In pediatrics, it is one of the most common gastrointestinal diseases causing intestinal obstruction. The majority of intussusception in children do not have demonstrable cause and most frequently occur in the ileocecal area [1, 2]. On the contrary, it is relatively rare in adults, and mainly involves the small intestine. Also, intraluminal tumors are known to be the major cause of adult intussusception [3].

Small intestine cancer is also very rare, occupying 0.6% of newly diagnosed cancer in the United States [4]. Adenocarcinoma and carcinoid tumor are the most common subtypes, accounting for 60–80% of small intestine cancers, while sarcoma and lymphoma account for 20–30% [5, 6]. Among various types of small intestine cancer, undifferentiated carcinoma is a very rare malignancy that cannot be classified into a specific histological type. Therefore, it is classified into a separate category in the WHO classification [7].

^{18}F -fluorodeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) is a very commonly used nuclear imaging tool to assess the stage of malignancy [8]. It can detect distant metastasis and incidental malignancy due to the visualization of the metabolic activity and whole body coverage. Here, we present the case in that a patient who had incidentally found small intestine intussusception during the initial work-up for a lung mass, which was proven as undifferentiated carcinoma originating from the small intestine.

Case Report

A 72-year-old man with a chief complaint of dyspnea was referred to our center for further evaluation of a lung mass that

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was initially found on chest radiography. He had history of 46 pack-years of smoking and tuberculosis in his 30s. The initial laboratory test also demonstrated a low hemoglobin (Hb) level of 6.9 g/dL, indicating severe anemia state, even though he denied any history of melena, hematochezia, or hematemesis. He was hospitalized in order to perform malignancy workup for lung mass and search possible causes of severe anemia.

As initial work-up for the lung lesions, simple chest X-ray and chest CT were performed. A mass in the right upper lung (RUL) was observed in both of chest radiograph and chest CT, and was suspected as lung cancer. To investigate the cause of anemia, esophagogastroduodenoscopy and colonoscopy were performed, and they revealed no specific finding except for a positive fecal occult blood. Laboratory tests results indicated that the patient had iron deficiency anemia (IDA) with a mean corpuscular volume (MCV) of 75.3 fL, mean corpuscular hemoglobin (MCH) of 23.7 pg, and mean corpuscular hemoglobin concentration (MCHC) of 31.5 g/dL.

Subsequently, percutaneous needle biopsy for the RUL lesion was performed, and the initial pathological evaluation suggested the tumor in the biopsy specimen as large cell undifferentiated carcinoma with neuroendocrine features. Then, FDG PET/CT was performed to assess the stage of the suspected lung cancer in RUL (Fig. 1). The mass in the

RUL showed intensely increased FDG uptake, and maximal standardized uptake value (SUVmax) was calculated to be 12.4, which suggested a high possibility of malignancy. In addition, ipsilateral mediastinal lymph nodes with mildly increased FDG uptake were detected, which were suspected to be metastases. Accidentally circumferential wall thickening with intraluminal mass was also identified with intense FDG uptake (SUVmax: 9.2) in the small intestine. Based on these findings, we suggested the small intestine intussusception and possible associated malignancy.

For further evaluation of the lesion in the small intestine, contrast enhanced CT of abdomen and pelvis was recommended (Fig. 2). Invagination of the small intestine was clearly visualized in the CT, due to its great contrast. The patient was referred to the department of surgery and small intestine resection was conducted immediately. The small intestine mass was resected and anastomosed (Fig. 3a). The size of the small intestine mass was $6.8 \times 6.5 \times 2.4$ cm and the mucosa until the subserosa was involved. Pathologic diagnosis was suggested as an undifferentiated carcinoma with neuroendocrine feature or a poorly differentiated carcinoma, possibly neuroendocrine carcinoma. Approximately 3 weeks after small intestine resection, video-assisted thoracoscopic surgery (VATS) lobectomy for RUL lesion was performed (Fig. 3b).

Fig. 1 FDG PET/CT images of a 72-years-old male patient suspected of right upper lobe lung cancer. **a** A maximal intensity projection (MIP) image shows a right upper lung mass with increased FDG uptake, and an SUVmax of 12.4 (long arrow). Ipsilateral mediastinal lymph nodes are shown with mildly increased FDG uptake (arrowheads). In addition, a hypermetabolic lesion is detected incidentally in the abdominal cavity (levels B and C). **b** A small intestine intussusception lesion at the level

B is seen as a circumferential wall thickened mass with a so-called “doughnut sign” or “target sign”, and the wall thickened portion and increased FDG lesion were well matched. **c** A hypermetabolic lesion filled in the bowel cavity in the left side of the abdominal cavity at level C, which showed hypermetabolism of SUVmax of 9.2. The lesion was pathologically confirmed as an undifferentiated carcinoma with neuroendocrine feature

Fig. 2 Abdomen contrast CT images of the patient. **a** In coronal image, invagination of the small intestine is identified, which is highly suggestive of intussusception. **b** In axial image at the level B, multilayered wall thickening is very well visualized with great contrast (arrow). Additionally, it depicts several enlarged lymph nodes with possibility of metastatic lymph nodes (arrowhead). **c** In axial image at level C, an enhanced mass lesion was shown inside the bowel cavity (arrow)

The size of the resected lung mass was $4.9 \times 4.5 \times 3.5$ cm, and no regional lymph node metastasis was detected.

For further pathological evaluation of the origin of the tumors, immunohistochemistry staining of the pathologic

specimens from both the small intestine and lung was conducted. The results showed diffuse strong positive for Vimentin, which is a marker for mesenchymal origin; while cytokeratin 7 and 20 as markers for epithelial origins were

Fig. 3 Gross findings of small intestine lesion and lung lesion. **a** Small intestine intussusception was resected (arrow). Ulcerative mass was found in the invaginated small intestine (arrowhead). **b** RUL lesion was resected. A white-colored mass with definite margin was found

negative in both tumors from small intestine and lung. No specific markers to determine whether the tumor originated from lung was detected in the immunohistochemistry for lung tissue. After considering all pathological results, it was concluded that the tumors in the small intestine was an undifferentiated carcinoma with neuroendocrine feature, and the lung lesion was determined to be a metastatic tumor from the small intestine carcinoma [9].

The final diagnosis was small intestine undifferentiated carcinoma with lung metastasis. The patient was on close follow up after surgery without any further treatment, such as adjuvant chemotherapy.

Discussion

Intussusception is an uncommon disease in adults. Generally, CT demonstrates multilayered target-like mass [10] and ultrasonography demonstrates “doughnut sign”, which is a very typical and classic finding [11]. Despite the limitation of non-contrast CT, we could suggest the possibility of intussusception because of high FDG uptake and circumferential wall thickening appearance. Although many factors may contribute to induce intussusception, an intraluminal tumor is known as a common cause. Therefore, it is very important to perform further evaluation and proper management when intussusception is identified in adults. In this case, FDG PET/CT finding was very helpful to detect the unexpected intussusception with high suspicion of malignancy, which was proven as the main focus of malignancy finally.

Actually, there have been a few reports to demonstrate FDG PET/CT finding to identify small intestine intussusception. Most of these cases were proven as small intestine lymphoma [12–14]. However, lymphoma is not so uncommon, accounting for approximately 20–40% of all malignancies in small intestine [15]. Lee et al. reported the case of small intestine metastasis of lung cancer [16]. To our best knowledge, this is the first report which demonstrated FDG PET/CT finding of primary small intestine cancer with lung metastasis.

FDG uptake of small intestine intussusception can be explained by two possible mechanisms. First, small intestine intussusception is mainly caused by malignancy in adults as previously mentioned. Therefore, FDG uptake of malignant lesion in small intestine can be demonstrated with intussusception. In our case, carcinoma cells involved from mucosa to subserosa according to pathologic examination. Malignant cells infiltrating into small intestine wall might contribute to FDG uptake of small intestine intussusception. Second, inflammatory activity is frequently associated in intussusception, so that it may show increased FDG uptake.

Undifferentiated carcinoma, which is called anaplastic carcinoma, is a very rare type among various gastrointestinal tumors. The primary treatment option is surgical resection

followed by chemotherapy and radiation therapy, the same as other typical malignancies. However, its prognosis is relatively poorer than carcinoma or adenocarcinoma. In this report, the patient was diagnosed with lung metastasis so that poor prognosis was expected. Nevertheless, FDG PET/CT revealed unknown primary malignancy site to make physicians perform main treatment immediately. In this regard, FDG PET/CT contributed to alter physician’s decision and improve patient’s prognosis even though it was minimal.

In conclusion, FDG PET/CT can detect unexpected primary malignancy presenting as small intestine intussusception in this case. In addition, non-contrast CT can visualize anatomical location and gross appearance of a lesion to characterize it easily. This case demonstrates that FDG PET/CT can detect small intestine cancer with intussusception and suggest proper management.

Compliance with Ethical Standards

Conflict of Interest Hyunjong Lee, So Won Oh, and Yu Kyeong Kim declare that they have no conflict of interest.

Ethical Statement The report is a case report for which approval by an institutional review board is waived.

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