Needle Tract Seeding: An Overlooked Rare Complication of Endoscopic Ultrasound-Guided Fine-Needle Aspiration

Kosuke Minaga^a Mamoru Takenaka^a Akio Katanuma^b Masayuki Kitano^c
Yukitaka Yamashita^d Ken Kamata^a Kentaro Yamao^a Tomohiro Watanabe^a
Hiroyuki Maguchi^b Masatoshi Kudo^a

^aDepartment of Gastroenterology and Hepatology, Kindai University Faculty of Medicine, Osaka-Sayama,

^bCenter for Gastroenterology, Teine-Keijinkai Hospital, Sapporo, ^cSecond Department of Internal Medicine, Wakayama Medical University School of Medicine, and ^dDepartment of Gastroenterology and Hepatology, Japanese Red Cross Society Wakayama Medical Center, Wakayama, Japan

Keywords

Endoscopic ultrasound · Endoscopic ultrasound-guided fine-needle aspiration · Needle tract seeding · Tumor seeding · Seeding

Abstract

Endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) has been widely used for diagnosis of both inflammatory and tumor lesions located in and adjacent to the gastrointestinal tract. EUS-FNA has been considered to be a safe technique with few complications, as shown in recent review articles in which EUS-FNA-related morbidity and mortality rates were reported to be <1%. It should be noted, however, that needle tract seeding, although uncommon, can occur after diagnostic EUS-FNA and that this complication affects the prognosis of patients. Although an accurate value for the frequency of needle tract seeding caused by EUS-FNA has not been reported, the numbers of case reports on needle tract seeding have been rapidly increasing, especially in Ja-

pan. These case reports regarding EUS-FNA-related needle tract seeding prompted us to reevaluate the safety of EUS-FNA because this complication may have a significant influence on patients' prognoses. In this review, we summarize the clinical features and outcomes of needle tract seeding after EUS on the basis of the previously reported cases and provide useful information to prevent and reduce this serious complication.

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Introduction

Since the first description in 1992 by Vilman et al. [1], the utility and efficacy of endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) have been well established in the diagnoses of a wide variety of lesions located in and adjacent to the gastrointestinal tract. Although EUS-FNA itself has been considered to be a very safe diagnostic modality with <1% of morbidity and mortality

rates [2], it is not free from complications. The most common complications of EUS-FNA include infections, bleeding, and pancreatitis. Moreover, a number of recent case studies have highlighted the importance of needle tract seeding as a rare but serious complication associated with EUS-FNA. Although an accurate value for the frequency of needle tract seeding following EUS-FNA has not been reported yet, the numbers of case reports regarding needle tract seeding have been increasing, especially those by Japanese endosonographers. Probably, this complication remains underreported. In this review, we summarize the clinical features and outcomes of needle tract seeding obtained from an extensive analysis of previously published reported cases.

Methods

This review is based on the results of searches performed in the Medline/PubMed and Cochrane Library electronic databases of studies published between June 1996 and June 2017 using the keywords “EUS OR endoscopic ultrasound” AND “seeding.” The initial search identified 80 articles. Of these, 32 articles were considered relevant to this review through the screening of their titles. After careful reading of the abstracts, the complete texts were obtained for potentially relevant articles. Finally, we included a total of 29 references focusing on EUS-FNA-related complications and found 15 case reports regarding needle tract seeding following EUS-FNA.

Risk of Needle Tract Seeding following EUS-FNA

According to large retrospective surveys, the rate of needle tract seeding caused by percutaneous abdominal FNA is extremely low and ranges from 0.003 to 0.009% [3, 4]. Furthermore, a previous study suggested that needle tract seeding and/or peritoneal dissemination may be disregarded as possible complications following EUS-FNA because the rate of such complications is lower in EUS-FNA than in percutaneous FNA [5]. However, it has been suggested that the frequency of needle tract seeding might have been underestimated in previous studies because disease mortality was calculated without clear recognition of tumor dissemination [6]. More accurate rates of needle tract seeding caused by EUS-FNA have been obtained by later retrospective analyses. In cases of pancreatobiliary tumors, many studies have provided evidence that the EUS-FNA procedure itself did not increase the risk of needle tract seeding, peritoneal dissemination, or decreased survival [7–12]. For example, Ngamruengphong et al. [7] performed a retrospective study to ad-

dress whether preoperative EUS-FNA for pancreatic cancer is associated with an increased risk of stomach or peritoneal recurrence and whether the procedure affects long-term survival. In this retrospective study in 256 patients who underwent surgery with curative intent, preoperative EUS-FNA was performed in 208 patients, and a total of 16 patients had peritoneal recurrence. This group of 16 patients with peritoneal or gastric recurrence was composed of 5 patients in the non-EUS-FNA group and 11 patients in the EUS-FNA group. A multivariate analysis did not find a significant correlation between preoperative EUS-FNA and cancer recurrence in the stomach or peritoneal cavity [7]. Similar results were obtained in 2 other retrospective studies in which EUS-FNA did not increase the risk of tumor dissemination through the needle tract in pancreatic cancer [10, 11]. Regarding mucinous pancreatic cystic lesions, the PIPE study was conducted to assess the frequency of postoperative peritoneal seeding in patients with intraductal papillary mucinous neoplasm. In this study, preoperative EUS-FNA was not associated with an increased frequency of peritoneal seeding in patients who underwent surgery [8].

However, we need to be cautious in the interpretation of the results of these studies for the following reasons. First, the number of patients in these studies might be too small to sufficiently estimate the actual frequency of needle tract seeding, a rare complication of EUS-FNA. Second, the follow-up periods of these studies were rather short to observe the incidence or outcome of needle tract seeding. Taken together, these retrospective studies do not provide clinical evidence that needle tract seeding is a complication associated with EUS and that awareness of this complication is absolutely necessary before EUS-FNA.

In contrast to the retrospective studies shown above, a prospective study by Levy et al. [13] provided valuable information about the causal linkage of EUS-FNA to tumor dissemination. They evaluated the presence of malignant cells within gastrointestinal luminal fluid in patients who received diagnostic EUS-FNA for extraluminal sites, pancreatic cancer in this case. Surprisingly, post-FNA luminal fluid cytology was positive in 3 (11.5%) of 26 patients with pancreatic cancer, which suggested that translocation of malignant cells from pancreatic cancer tissue into the lumen of the gastrointestinal tract was evoked in a significant population of patients after diagnostic EUS-FNA [13]. Unfortunately, it remains unknown whether such translocation of malignant cells into the gastrointestinal lumen results in colonization and dissemination of tumor cells. Thus, the clinical significance of these results needs

Table 1. Clinical features and outcomes of 15 published cases of needle tract seeding following EUS-FNA

First author, year [ref.]	Country	Diagnosis, tumor staging	Details of EUS-FNA			Time interval	Details of tumor seeding		Outcomes
			puncture lumen	needle diameter, gauge	passes, <i>n</i>		seeding site	tumor size, mm	
Shah, 2004 [15]	USA	perigastric lymph node metastasis from malignant melanoma	transgastric	22	1	6 months	posterior gastric wall	30	surgery, further follow-up unknown
Paquin, 2005 [16]	Canada	pancreatic adenocarcinoma, T1N0M0	transgastric	22	5	21 months	posterior gastric wall	50	palliative chemotherapy, died 12 months after diagnosis
Doi, 2008 [17]	Japan	mediastinal lymph node metastasis from gastric cancer	transesophageal	19	1	21 months	esophageal wall	8	radiation, the lesion resolved after 2 months
Ahmed, 2011 [18]	USA	pancreatic adenocarcinoma, T2N0M0	transgastric	–	multiple	nearly 4 years	gastric wall	45	died with another malignancy
Chong, 2011 [19]	Australia	pancreatic adenocarcinoma, T2N0M0	transgastric	22	2	26 months	posterior gastric wall	40	unresectable, further follow-up unknown
Katanuma, 2012 [20]	Japan	pancreatic adenocarcinoma, T2N0M0	transgastric	22	4	22 months	posterior gastric wall	–	surgery, further follow-up unknown
Anderson, 2013 [21]	USA	pancreatic adenocarcinoma	–	–	–	–	gastroesophageal junction	10	not reported
Sakurada, 2015 [22]	Japan	pancreatic adenosquamous carcinoma, T2N0M0	transgastric	22	–	19 months	posterior gastric wall	20	surgery (curatively resected), further follow-up unknown
Minaga, 2015 [23]	Japan	pancreatic adenocarcinoma, T3N0M0	transgastric	22	3	8 months	posterior gastric wall	12	surgery, no recurrence after 27 months of follow-up
Tomonari, 2015 [24]	Japan	pancreatic adenocarcinoma, T3N0M0	transgastric	22	2	28 months	gastric wall	32	surgery, further follow-up unknown
Kita, 2016 [25]	Japan	pancreatic adenocarcinoma	transgastric	22	2	7 months	posterior gastric wall	–	not reported
Yamabe, 2016 [26]	Japan	intraductal papillary mucinous carcinoma	transgastric	25	–	3 months	posterior gastric wall	24	palliative chemotherapy, died 26 months after diagnosis
Minaga, 2016 [27]	Japan	pancreatic adenocarcinoma, T1N0M0	transgastric	22	3	24 months	posterior gastric wall	30	surgery, no recurrence after 18 months of follow-up
Iida, 2016 [28]	Japan	pancreatic adenocarcinoma, T3N0M0	transgastric	22	3	6 months	posterior gastric wall	18	surgery, re-recurrence in the upper gastric posterior wall
Goel, 2017 [29]	Australia	metastatic squamous cell carcinoma in the celiac axis of unknown origin	transgastric	19	2	11 months	posterior gastric wall	50	unresectable, further follow-up unknown
EUS-FNA, endoscopic ultrasound-guided fine-needle aspiration.									

to be clarified. However, the results of this study indicate that translocation of tumor cells into the gastrointestinal lumen might be involved in the development of tumor dissemination following EUS-FNA [6]. Collectively, previous retrospective and prospective studies have not clearly shown the accurate rate or outcome of needle tract seeding after EUS-FNA. Given that the occurrence of this complication is very low, the numbers of recruited patients in these studies might have been too small to draw definitive conclusions. Further prospective studies with a large number of patients are awaited to fully define the clinical characteristics of needle tract seeding following EUS-FNA. Therefore, at present, our knowledge regarding EUS-FNA-related needle tract seeding is exclusively obtained from case reports. In the following paragraphs, we discuss clinical characteristics of needle tract seeding through detailed analysis of each case report.

Cases of Needle Tract Seeding in the Literature

The first case of tumor dissemination caused by EUS-FNA was reported by Hirooka et al. [14] in 2003. They reported a case of EUS-FNA-caused peritoneal dissemination of an intraductal papillary mucinous tumor of stage I with T1N0M0. Since this first report of tumor dissemination, needle tract seeding has been reported in 15 cases following EUS-FNA [15–29]. Notably, 9 of 15 cases were reported from Japan. The details of the individual cases are shown in Table 1. Moreover, 12 (80%) of 15 cases of needle tract seeding were caused by diagnostic EUS-FNA of pancreatic cancer and pancreatic cystic tumors. In all 12 cases, the tumors were located in the body or tail of the pancreas. In 13 (86.7%) of 15 cases, EUS-FNA was performed via the gastric body to preferentially diagnose pancreatic body or tail lesions. No reports described the tumor seeding following EUS-FNA for pancreatic head lesions, which can be explained by the fact that the needle tract site may be resected together with a primary tumor in pancreatic head cancer. These data suggest that endosonographers need to bear in mind the possibility of needle tract seeding when performing EUS-FNA for resectable tumors located in the pancreatic body or tail.

Regarding the EUS-FNA procedure, a 22-G FNA needle was used in the majority of cases with EUS-related needle tract seeding. In most cases, vacuum suction from a syringe during the puncture was applied. The median number of needle passes was 2 (range 1–5). Whether the risk of tumor seeding is associated with the needle size or number of passes remains uncertain.

The interval from EUS-FNA to detection of needle tract seeding varies widely, with a median interval of 20 months (range 3–48). For detection of the seeding tumor, gastroscopy and imaging modalities, especially positron emission tomography, have been useful. Abnormal accumulation of fluorine-18-deoxyglucose locally into the seeding sites was detected in 6 cases.

In terms of the seeding site, tumor seeding was located in the gastric wall in 13 (86.7%) cases, in the esophageal wall in 1 case, and in the gastroesophageal junction in 1 case. The median seeding tumor size was 30 mm (range 8–50). Most of the seeding tumors manifested as a submucosal tumor-like mass because the tumor mainly arose from the submucosal muscle layer or serosa but not from the mucosal layer.

Regarding treatment of EUS-related needle tract seeding, surgical resection was performed in 7 cases. In 1 case of needle tract seeding that occurred in the esophageal wall, radiation therapy successfully resolved the lesion. In 2 cases, palliative chemotherapy was selected, and in the remaining 5 cases, the treatment methods were not reported. Among the 7 cases treated with surgical resection for EUS-FNA-related needle tract seeding, no tumor recurrence was observed in the 2 cases treated at our hospital at 27 and 18 months of follow-up, respectively, after surgical resection of the seeded lesions [23, 27]. In the other 5 cases treated with surgical resection, no detailed information about the patients' outcomes and follow-up was obtained. Thus, the long-term prognosis of surgically resected needle tract seeding is not well known. Most recently, Iida et al. [28] reported a re-recurrence case after radical surgical resection for EUS-FNA-related tumor seeding. In this case, distal gastrectomy was performed for needle tract seeding that occurred on the lower posterior wall of the gastric body. At 21 months after distal gastrectomy, re-recurrence was detected on the upper posterior wall of the operated gastric body. The authors suggested that total gastrectomy rather than simple surgical resection should be considered in such cases [28].

Although the optimal treatment strategy for needle tract seeding has not been established, early detection and surgical resection of needle tract seeded lesions may be very effective for achieving long-term survival in some cases. However, further studies are necessary to fully define the clinical characteristics of needle tract seeding cases that can be successfully treated with surgical resection. Moreover, it should also be emphasized that cautious follow-up of the needle puncture sites by performing endoscopy and imaging modalities for early detection of needle tract seeding is of great importance to ensure radical cure.

Prevention of Needle Tract Seeding

As mentioned earlier, needle tract seeding after EUS-FNA is a serious complication that may worsen patients' prognoses. Consequently, the question arises as to how we can perform EUS-FNA safely without increasing the risk of needle tract seeding. In this regard, a couple of suggestions have been made to reduce the risk of needle tract seeding. Fujii and Levy [6] reported that the risk of needle tract seeding may be reduced by performing EUS-FNA only when the results obtained by this procedure are useful for a patient's management. Technically, it is important to set the needle tract sites within the surgical resection margins in the cases of patients with resectable tumors to avoid needle tract seeding. Most cases of needle tract seeding have occurred after diagnostic EUS against lesions located in the pancreatic body or tail. In such cases, needle tract sites may be set in the gastric body, which may not be resected by surgery. Therefore, the risk-benefit ratio of EUS-FNA should be carefully considered in patients with potentially resectable lesions of the pancreatic body or tail, as Hirooka et al. suggested [14].

Careful follow-up using endoscopy and imaging modalities is necessary in cases in which the needle tract site is outside the surgical resection margins. In such cases, it may be mandatory to detect needle tract seeding before metastases occur to resect curatively.

Conclusions

Needle tract seeding following EUS-FNA is a rare but serious complication that may impair patients' survival. Therefore, endosonographers should bear in mind the possibility of needle tract seeding before EUS-FNA. Considering this serious complication, EUS-FNA should be performed only when the results obtained by this procedure are useful for therapeutic decision-making. Needle tract seeding following EUS-FNA might be avoided by setting the needle tract line within the surgical resection margins, if technically possible. Carefully planned endoscopic and imaging surveillance of the puncture sites could lead to early detection of needle tract seeding, which may improve the prognosis. Further prospective studies with a larger cohort are required to estimate the risk of needle tract seeding following EUS-FNA.

Disclosure Statement

The authors have no financial conflicts of interest to declare concerning this article.

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