Follow up CT Findings of Various Types of Recurrence after Curative Gastric Surgery

Hye-Jeong Lee, M.D., Myeong-Jin Kim, M.D., Joon Seok Lim, M.D., Ki Whang Kim, M.D.

Although the detection of recurred lesions following curative gastrectomy in patients with gastric cancer has increased as the use of computed tomography (CT) has grown, early or small tumor recurrence can be difficult to identify or correctly diagnose using CT. Therefore, in this study, we retrospectively reviewed cases in which tumor recurrence was missed upon analysis of the follow up CT after gastrectomy. The characteristics of the lesions in various locations of the abdomen and pelvis are illustrated and discussed.

**Index words**: Stomach neoplasms
- Tomography, X-Ray computed
- Neoplasm recurrence, local
- Retrospective studies

Complete resection of a gastric tumor including the adjacent lymph nodes is considered to be the only effective curative treatment modality for patients with gastric cancer [1]. In spite of this, local or systemic recurrent lesions can develop in various locations of the abdomen and pelvis through several routes, therefore, early detection and treatment of recurrence is important for improving the quality of life and survival of gastric cancer patients. CT plays an important role in evaluating suspected recurrence of tumors, however, early detection of recurrence or detection of small tumors can be difficult identify and correctly diagnose [2, 3]. Therefore, we conducted this retrospective review of cases in which recurrence occurred but was not identified on CT analysis to determine the reason the lesions were not identified. The site, shape, and attenuation characteristics of those lesions were reviewed and illustrated.

**Patterns of Tumor Recurrence**

The main patterns of recurrence after the removal of gastric cancer were as follows:
- Local recurrence: anastomosis or stump, adjacent organ, abdominal incision site
- Lymph nodes
- Peritoneal seeding
- Hematogeneous metastasis: liver, lung, bone, brain
- Unusual metastasis

**Local Recurrence**

Local recurrence of gastric carcinoma after surgery is defined as histologic evidence of a tumor in the surrounding tissues of the resected stomach [4].
Anastomosis and gastric stump

Local recurrence of gastric cancer most commonly involves the region of the gastric stump or anastomosis (3). Recurrence in this region manifests as an asymmetrical or circumferential thickening of the anastomotic or remnant gastric wall (Fig. 1) (1). However, even if thickening of the remnant gastric wall does not occur, the presence of a focal attenuation abnormality at the remnant stomach or small bowel wall around the anastomosis site should prompt an endoscopic examination (Fig. 2) to differentiate between recurrence and benign conditions, including gastritis. In addition, abnormal distension of the bowel loop around the anastomosis site, including afferent or efferent loops, also suggest the possibility of tumor recurrence (Fig. 3), however this condition may also be caused by an obstruction due to the presence of adhesive bands.

Fig. 1. A 36-year-old woman underwent total gastrectomy to treat adenocarcinoma. [A, B] Follow-up CT revealed the presence of focal asymmetric wall thickening of the anastomosis site (arrows) 12 months after gastrectomy. The wall thickness measured 1.5 cm. The patient underwent endoscopic biopsy, which revealed that tumor recurrence had occurred at the site of anastomosis.

Fig. 2. A 66-year-old man underwent subtotal gastrectomy to treat adenocarcinoma. [A] Follow-up CT 2 years after gastrectomy revealed a suspicious focal wall thickening with low attenuation (arrow) at the remnant stomach, which was considered to be nonspecific gastritis at the time of the CT analysis. [B] After 7 months, a subsequent follow-up CT revealed the progression of mural thickening (arrow) at the remnant stomach.

Fig. 3. A 58-year-old woman underwent subtotal gastrectomy to treat adenocarcinoma. [A] There was no abnormality observed on the follow-up CT taken 20 months after gastrectomy. [B] A follow-up CT taken 33 months later, however, revealed the presence subtle wall thickening at anastomosis site; however, this thickening was not considered to be a recurrent lesion at that time. [C] A follow-up CT taken three months later revealed that the mural thickening (arrows) at the anastomosis site had progressed. An endoscopic biopsy confirmed that tumor recurrence had occurred at the same location.
Recurrences at the abdominal incision site caused by iatrogenic dissemination of cancer cells during the operation are usually seen as a soft tissue attenuation mass (4). However, differentiation based on postoperative fibrosis or granulation may be difficult, therefore, comparison of a postoperative baseline study with CT taken 3-6 months after surgery can be helpful for determining the correct diagnosis (Fig. 4). In addition, the presence of a painful or growing nodule at the incision site should also be carefully evaluated.

**Abdominal incision site**

**Lymph Nodes**

Lymph node metastases comprise the majority of tumor recurrences (3), and the most common locations of metastatic lymphadenopathy include the region along the common hepatic artery, celiac axis, the hepatoduodenal ligament and the periaortic region (4). The pattern of lymphatic recurrence is seen as a conglomerated (4) or infiltrative mass, or as an obliteration of the fat in these regions (Fig. 5, 6). Lymph nodes larger than 10 mm observed in the short axis are usually regarded as abnormal and indicative of metastasis, however, the

---

**Fig. 4.** A 41-year-old man underwent subtotal gastrectomy to treat adenocarcinoma.

A. The baseline CT revealed a fibrotic scar at the incision site (arrow), but no evidence of growth of the mass.

B. A follow-up CT taken 12 months after the gastrectomy revealed the presence of a peripherally enhancing nodule at the abdominal wall incision site (arrow), however, at the time of the CT no action was taken.

C. A CT scan taken 6 months later revealed that the lesion had grown (arrow).

**Fig. 5.** An 80-year-old man underwent total gastrectomy to treat adenocarcinoma.

A, B. Obliteration of the fat surrounding the celiac axis (arrow) and SMA root (open arrow) was observed on the follow-up CT taken 15 months after gastrectomy, however at the time that CT was conducted this was considered to be postoperative fibrosis.

C, D. A follow-up CT taken one year later revealed that the soft tissue thickening around the celiac axis (arrow) and SMA root (open arrow) had grown. After chemotherapy, the soft tissue decreased in size and left a scar.
sensitivity and specificity of diagnosis can be poor if it is based solely on size criteria. Therefore the increase in the number and size lymph nodes in comparison to those observed on a previous CT is an important sign of nodal recurrence (Fig. 7). In addition, an area of low attenuation within a lymph node is another important sign of recurrence, however, such areas are very small, therefore, occasional analysis using positron emission tomography (PET) may be helpful in the differential diagnosis of small lymph nodes. Furthermore, metastatic lymph nodes with or without necrosis can mimic normal structures, such as the small bowel or other solid organs, therefore careful inspection of the adjacent sectional images is necessary [Fig. 8, 9].

**Peritoneal Seeding**

Ascites, which is one of the most common findings of peritoneal seeding in cases of stomach cancer, has been reported in up to 74% of cases [5]. Ascitic fluid is often loculated and/or septated, and can be seen in non-dependent areas of the abdomen, including the greater and lesser sacs, even in when it is not found in dependent areas such as the pelvis [5]. Peritoneal implants are soft-tissue masses that appear as solitary or multiple nodules and tend to occur at sites that coincide with the natural

---

**Fig. 6.** A 55-year-old man underwent total gastrectomy to treat adenocarcinoma.  
**A.** Follow-up CT did not reveal the presence of any abnormalities in the same location 4 months after surgery.  
**B.** However, a CT scan taken 7 months later revealed new obliteration of fat in the retropancreatic area [arrow], which was suggestive of recurrence.  
**C.** A Follow-up CT taken 10 months later after gastrectomy revealed further progression of the recurrent tumor [arrow].

---

**Fig. 7.** A 50-year-old man underwent subtotal gastrectomy to treat adenocarcinoma.  
**A.** Follow-up CT conducted 4 months after the gastrectomy showed no evidence of recurrence.  
**B.** Several lymph nodes (5 mm in short diameter) were seen in the gastroplenic ligament [arrow] on the next follow-up CT, which was taken 2 months later.  
**C.** The lymph nodes were seen as hot spots [arrow] on the FDG-PET conducted at the time.  
**D.** A follow-up CT taken 4 months later revealed progression of the lymph nodes [arrow].
flow of peritoneal fluid. These sites include the superior aspect of the terminal ileum, the medial aspect of the cecum, and the superior aspect of the sigmoid colon, the pelvis (especially, cul-de-sac) the paracolic gutter, and the subhepatic and subphrenic spaces on the right. In addition, the peritoneal surfaces of the diaphragm, liver, spleen, and the greater omentum are also common sites of tumor deposition (6). Therefore, careful inspection of these areas is important to ensure that any areas of irregular soft tissue thickening and/or soft tissue nodules (Fig. 10-13) are identified.

**Hematogenous Metastases**

Because the venous return from the stomach is drained by the portal vein, the liver is the most common site of hematogenous metastases (1). Hepatic metastases usually appear as areas of hypoattenuation on portal venous phase CT. If a dynamic scan is performed, an irregular peripheral rim enhancement around the hypo-

---

**Fig. 8.** A 39-year-old man underwent total gastrectomy to treat signet ring cell carcinoma.

**A.** A recurrent lesion at the retropancreatic area [arrow] was not observed on the initial follow-up CT because of its similar attenuation with the surrounding bowel and pancreas.

**B.** The progression of metastatic lymphadenopathy [arrow] was detected on a follow up CT taken 6 months later.

**Fig. 9.** A 64-year-old man presented with jaundice 3.5 years after undergoing gastrectomy to treat adenocarcinoma.

**A.** CT revealed soft tissue attenuation at the periportal areas [arrow], which were regarded as part of the pancreas at the time.

**B.** Growing lymph nodes [arrow] were seen in porta hepatis on the follow-up CT, with compression of the common bile duct resulting in dilation of the intrahepatic bile duct (open arrow).

---

**Fig. 10.** A 61-year-old woman presented with abdominal distension 3 years after undergoing subtotal gastrectomy to treat signet ring cell carcinoma.

**A.** CT depicted a subtle nodular thickening of the peritoneum [arrow] with fluid collection in the pelvic cavity, which was neglected at the time.

**B, C.** A follow-up CT taken 3 months later revealed a marked increase in the amount of ascites [arrow heads] and progression of diffuse peritoneal thickening [arrow].
poattenuating center may be seen on the arterial phase and peripheral washout, and central enhancement can be seen on the delayed phase (Fig. 14). Less common sites of hematogenous metastases include the lungs, adrenal glands, kidneys and bones [2]. To avoid overlooking metastasis of the lungs and bone, careful inspection of these areas by adjusting the window width is important. Ovarian metastases, which are also known as Krukenberg’s tumors, occur in nearly 10% of the cases of gastric cancer, and are especially common in signet-ring cell type cancer [1], which produces bilateral smoothly enlarged ovaries that are diffusely infiltrated microscopically by tumor cells. Krukenberg’s tumors should be suspected when solid ovarian tumors containing well demarcated intratumoral cystic lesions are observed on the CT scan, especially if the walls of such cysts demonstrate a particularly strong contrast enhancement (Fig. 15).

**Unusual Manifestations of Metastasis**

Various forms of other recurrent tumors, including metastatic linitis platisca to the rectum, peribiliary tumor spread, portal vein tumor thrombosis, urinary bladder metastasis and ureter metastasis can also be encountered.

Linitis platisca refers to diffuse proliferation of the connective tissue of a hollow organ. The stomach is the most common primary site of metastatic linitis plastica [7], and the most common finding of metastatic linitis plastica to the rectum was concentric bowel wall thickening with a target sign on contrast enhanced CT (Fig. 16).

---

**Fig. 11.** A 66-year-old man underwent subtotal gastrectomy to treat adenocarcinoma.
A. A follow-up CT taken 2 years after gastrectomy demonstrated a soft tissue nodule at the right paracolic gutter (arrow), which was not perceived at that time.
B. A CT conducted 6 months later revealed a marked enlargement of a soft mass (arrow) at the same location.

**Fig. 12.** A 75-year-old man underwent total gastrectomy to treat adenocarcinoma.
A. A follow-up CT revealed a subtle irregularity along the lateral wall of the ascending colon (arrow).
B. A nodule with peripheral enhancement in the paracolic gutter (arrow) and ascites in the peritoneal cavity (open arrow) were noted on another follow-up CT that was conducted 3 years after the gastrectomy.

**Fig. 13.** A 66-year-old man underwent subtotal gastrectomy to treat adenocarcinoma.
A. A small nodule in the rectal shelf (arrow) was overlooked during a follow-up CT conducted 2 years after the gastrectomy.
B. Follow-up CT 7 months later demonstrated that this nodule had become enlarged (arrow).
Peribiliary tumor spread is usually associated with metastatic lymphadenopathy along the common hepatic artery, celiac axis, or hepatoduodenal ligament, and peribiliary tumors can be identified based on the presence of irregular thickening of the biliary duct with proximal biliary duct dilatation [Fig. 17]. Although rare, portal venous thrombosis may occur in cases of invasive gastric carcinoma, possibly as a result of portal vein invasion by the liver metastatic tumor or direct portal venous invasion from the primary foci of gastric cancer [Fig. 18] [8].

**Fig. 14.** A 71-year-old man underwent total gastrectomy to treat adenocarcinoma. 
A. The initial follow-up CT revealed no abnormal lesions in the liver. 
B. Although a newly developed small low attenuated lesion (arrow) was observed on a follow-up CT taken 3 months later, the lesion was not observed at that time because of its small size. 
C. On the next follow-up CT, a central necrotic mass with an area of peripheral enhancement was observed in the right lobe of the liver, which is suggestive of metastasis (arrow).

**Fig. 15.** A 38-year-old woman underwent total gastrectomy to treat signet ring cell carcinoma. 
A. The mass (arrow) was retrospectively observed on the prior follow-up CT; however it was not initially regarded as a pathologic lesion. 
B. A follow-up CT revealed a complex mass with contrast enhancement of the right ovary, which is suggestive of a Krukenberg tumor (arrow). This patient underwent surgery, and the pathology of the mass was consistent with metastatic signet ring cell carcinoma.

**Fig. 16.** A 28-year-old woman presented with constipation 5 years after undergoing total gastrectomy to treat signet ring cell carcinoma. Follow-up CT (A-C) revealed concentric thickening of the rectal wall with a target sign, which is suggestive of metastatic linitis plastica to the rectum (arrows).
Metastatic tumors of the urinary bladder from distant primary foci are rare and represent only 1.5% of all bladder tumors. Metastatic bladder tumors can be identified by the presence of polypoid lesions that are similar to typical transitional cell carcinoma or focal thickening of the bladder wall [Fig. 19] (9).

Ureteral metastasis caused by gastric cancer may occur as a result of direct extension, peritoneal deposit, as well as lymphatic, or hematogeneous metastasis. Upon CT analysis, ureteral metastasis presents as concentric or asymmetric wall thickening of the ureter with obstructive hydronephrosis [Fig. 20]. However, a sclerotic reaction induced by cancer cells, known as malignant retroperitoneal fibrosis, can also invade the periureteral region without direct invasion of the ureter and lead to ureteral obstruction [Fig. 21] (10).

**Conclusion**

CT scan plays an important role in preoperative staging and postoperative surveillance. Although tumor recurrence indicates a poor prognosis, early identification
may allow patients to respond better to chemotherapy or radiation therapy.

Following gastrectomy, interpretation of a CT scan may be difficult because alteration of the normal anatomy and postoperative changes may mimic recurrent tumors. Moreover, recurrence of gastric cancer can be seen in various forms anywhere in the abdomen and pelvis. Therefore, being thoroughly familiar with the CT findings of recurrence after gastrectomy is important for ensuring accurate diagnosis.

Fig. 19. A 50-year-old man underwent total gastrectomy to treat mucinous adenocarcinoma. 
A. A follow up CT conducted 4 years after the gastrectomy revealed an area of suspicious soft tissue density with small calcification in the anterior wall of the urinary bladder (arrow), which was considered to be a partial volume effect at the time the CT was taken.
B. On the next follow-up CT, which was conducted 7 months later, a soft tissue nodule with small calcification [arrow] in the same location was clearly detected. The patient underwent surgery and the pathology of the nodule confirmed the presence of metastatic mucinous adenocarcinoma as a result of stomach cancer.

Fig. 20. A 63-year-old man underwent subtotal gastrectomy due to adenocarcinoma. A follow-up CT conducted two years after gastrectomy revealed (A) conglomerated paraaortic lymphadenopathy (arrow head) (B) with left ureteral metastasis (arrow), which resulted in obstructive hydronephrosis.

Fig. 21. A 54-year-old man underwent subtotal gastrectomy due to adenocarcinoma. A follow-up CT conducted 3 years after gastrectomy revealed the presence of fibrotic soft tissues around the aorta with suspicious left ureteral wall thickening. Decreased perfusion in the Lt. kidney and mild dilatation of the Lt. pelvis were also observed.

References

2. Kim KA, Park CM, Park SW, Cha SH, Seol HY, Cha IH, et al. CT findings in the abdomen and pelvis after gastric carcinoma resec-
Hye-Jeong Lee, et al: Follow up CT Findings of Various Types of Recurrence after Curative Gastric Surgery

이대성장신경 2007;57:553-562

1.

<table>
<thead>
<tr>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>1</th>
</tr>
</thead>
</table>