CT findings of Intramural blood pool in intramural hematoma: significant differential diagnosis of ulcer-like projection

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Aims and objectives

Purpose:
To assess the radiological findings of intramural blood pools (IBPs) in patients with intramural hematoma (IMH) in acute aortic syndrome, with the focus on IBP differentiation from ulcer-like projections (ULPs).

Background:
- Acute aortic syndrome (AAS) is clinically characterized by aortic pain and classified into 3 types by Vilacosta (2001): aortic dissection, intramural hematoma, or penetrating atherosclerotic ulcer [1].

- Intramural hematoma (IMH) is originally defined by its radiological findings on non-enhanced CT: a hyperdense, crescent-shaped lesion in the aortic wall without intimal tears. Recently, IMH has become considered as one of the subtypes of aortic dissection; a false lumen is thrombosed after an initial intimal tear is healed or a minor intimal tear is hardly detected by conventional imaging modalities.

- IMH was originally defined as having no demonstrable intimal flap; however, recent modern imaging technology sometimes detects a minor intimal lesion (ulcer-like projection) in the initial or follow-up imaging. The presence of a ULP suggests a high risk of rupture or expansion of the aorta, and IMH with a ULP significantly increases aorta-related events, presenting a significant difference in survival rate [2].

- Recently, several studies have reported on intramural blood pools [3]. IBPs are found in patients with IMH, and although the CT findings of IBPs are similar to those of ULPs and sometimes misdiagnosed, prognosis for IBPs is significantly different from that of ULPs. In this study, we investigated the radiological findings of IBPs in patients with IMH, with a particular focus on their differentiation from ULPs.

Methods and materials

Material and methods:
- The institutional review board approved this retrospective study and waived the need for informed consent.

- A total of 198 consecutive patients referred to our ER department and suspected of having acute aortic syndrome between 2004 and 2012 were potentially enrolled. Of these,
101 patients were diagnosed with IMH and assessed in this study (median age of 69 years, range of 38-89 years; 67 men and 34 women) (Table 1).

Image acquisition:

- For all patients, CT was performed with a 64-detector row scanner (Aquilion 64; Toshiba Medical Systems, Tokyo, Japan) or a 16-detector row scanner (BrightSpeed Elite; GE Healthcare, Milwaukee, WI, USA). A nonionic contrast-enhanced medium (Iopamidol, 370 mg/mL; Bayer Schering, Berlin Germany) was administrated using power injection at a rate of 2-3.5 mL/s.

- Non-contrast-enhanced whole body CT was followed by contrast-enhanced CT in the arterial (35 s) and portal venous (90 s) phases after injection. Optimized scan timing for the arterial phase of contrast enhancement was monitored with a bolus-tracking technique (threshold of 300 HU in the ascending aorta). Scanning parameters were 120 kV, 100-200 mAs, and reconstruction at 1-5-mm thickness for the enhanced CT.

Image assessment:

CT imaging was assessed for the presence of IBPs and ULPs, in addition to the size, morphology, and clinical outcome of IBPs and ULPs.

1) Assessment of IBPs and ULPs:

- IBPs are defined as isolated pooling of the contrast medium in the IMH, commonly having no major communications or only minor linear communications to the true lumen (1-2 mm). The lesion is typically located near the ostium of the bronchial arteries or intercostal arteries and may sometimes be accompanied by a minor connection.

- ULPs are defined as focal, contrast-filled outpouchings projecting from the aortic lumen of an IMH.

2) Imaging findings:

- Size of lesion
- Number of lesions
- Presence of communication with bronchial/intercostal arteries
- Location of lesion (ascending aorta, aortic arch, descending aorta, thoracoabdominal junction, or abdominal aorta)
- Clinical outcomes of lesion (date from onset to disappearance)

Images for this section:

Table 1: Inclusion criteria
Results

Results:

IBPs

- Forty lesions in 18 patients were observed (14 men and 4 women, median age of 61.5 years, ranging from 43-79 years).

- Patients had an average of 2 lesions, and 1 patient had a total of 9 lesions. The average size of lesions was 6 mm (ranging from 2-17 mm).

- Twenty lesions had a communication to a branch of the aortic artery: 4 (20%) had communication with a bronchial artery, 11 (55%) had communication with an intercostal artery, 4 (20%) had communication with a lumber artery, and 1 (5%) had communication with the right inferior phrenic artery.

- Four lesions were located in the aortic arch (10%), 27 in the descending aorta (67.5%), 5 in the thoracoabdominal junction of the aorta (12.5%), and 4 in the abdominal aorta (10%). No lesions were found in the ascending aorta.

- During follow-up, 31 out of 40 lesions disappeared in an average of 4 days (ranging from 1-2,557 days) from onset. Six lesions showed no interval change and 3 lesions were not followed-up because of death (Tables 2-4, Fig1-4:Case Presentations 1 and 2).

ULP

- Sixteen lesions in 16 patients were observed (14 men and 3 women, median age of 65.5 years, ranging from 46-84 years). All patients had a single lesion each, and the average size of lesions was 7.8 mm (ranging from 4-25 mm).

- There were no connections to branches of the aorta.

- One lesion was located in the ascending aorta (6.25%), 10 in the aortic arch (62.5%), 3 in the descending aorta (18.7%), and 2 in the thoracoabdominal junction of the aorta (12.5%). No lesions were found in the abdominal aorta.

During follow-up, 1 out of 16 (6.25%) lesions disappeared. Seven (43.7%) lesions showed no interval change and 3 (18.7%) lesions were not followed-up owing to death or change in hospital. Five (31.2%) lesions increased in size and 3 out of 5 cases (60%) required operation (Tables 2-4, Fig1-4:Case Presentations 1 and 2).

Images for this section:
### Table 2: Result 1

<table>
<thead>
<tr>
<th></th>
<th>IBPs</th>
<th>ULP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>40 IBPs in 18 patients</td>
<td>16 ULPs in 16 patients</td>
</tr>
<tr>
<td>Size</td>
<td>2-17mm (Median 6mm)</td>
<td>4-25mm (Median 7.8mm)</td>
</tr>
<tr>
<td>Number of IBPs in a patient</td>
<td>1-9 (median 2)</td>
<td>All patients have one ULP</td>
</tr>
</tbody>
</table>
| Connection to branches of aorta | 20/40 (50%)  
Bronchial artery 4/20 (20%)  
Intercostal artery 11/20 (55%)  
Lumber artery 4/20 (20%)  
Inferior phrenic artery 1/20 (5%) | 0 (0%)       |
### Table 3: Result 2

<table>
<thead>
<tr>
<th>Location</th>
<th>IBPs</th>
<th>ULP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascending aorta</td>
<td>0 (0%)</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td>Aortic arch</td>
<td>4 (10%)</td>
<td>10 (62.5%)</td>
</tr>
<tr>
<td>Descending aorta</td>
<td>27 (67.5%)</td>
<td>3 (18.7%)</td>
</tr>
<tr>
<td>Thoraco-abdominal junction</td>
<td>5 (12.5%)</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td>Abdominal aorta</td>
<td>4 (10%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

**Outcome**

<table>
<thead>
<tr>
<th>outcome</th>
<th>IBPs (40)</th>
<th>ULP (16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disappeared</td>
<td>31 (77.5%)</td>
<td>1 (6.25%)</td>
</tr>
<tr>
<td></td>
<td>Time to disappearance of IBPs 1-2557 (median 4) days</td>
<td></td>
</tr>
<tr>
<td>No change</td>
<td>6 (15%)</td>
<td>7 (43.7%)</td>
</tr>
<tr>
<td>unclear</td>
<td>3 (7.5%)</td>
<td>3 (18.7%)</td>
</tr>
<tr>
<td>increased</td>
<td>0</td>
<td>5 (31.2%)</td>
</tr>
</tbody>
</table>

* Unclear case is no follow up CT (the reason is changing hospital, death.)
* Increased case of ULP has two case operation (Insert EVAR or operation)

**Table 4:** Outcome
**Fig. 1:** Case presentation 1-1
Fig. 2: Case presentation 1-2
Fig. 3: Case presentation 2-1
Fig. 4: Case presentation 2-2
Conclusion

Conclusion:

- Although IBPs in IMH are sometimes misdiagnosed as ULPs, their clinical course and prognosis are quite different.

- IPBs in IMH commonly have no major communications, although they may have minor linear communications to the true lumen. IBPs are mainly located within the descending aorta, and commonly have connections to bronchial or intercostal arteries.

- ULPs in IMH indicate a primary intimal tear (namely a minor entry between the true lumen and false lumen of a thrombosed aortic dissection) and have a direct major connection with the lumen.

- A differential diagnosis between IBPs and ULPs is essential because the prognosis is quite different. Most IBPs disappear during the course of follow-up without aggressive treatment. Conversely, ULPs sometimes develop into classical aortic dissection, possibly requiring surgical or interventional treatment.

- Study limitations include the retrospective nature of the study, and hence possible patient selection bias, as well as diagnosis of IBPs and ULP based on imaging findings not confirmed by pathological examination.

- In conclusion, IBPs are sometimes observed in aortic dissections of IMH on multi-detector CT, and as these findings don't have the poor prognosis or clinical course of ULPs, it is important to correctly distinguish IBPs from ULPs.

Personal information

References

References:

3. Ming-Ting Wu, MD, Intramural blood pools accompanying aortic intramural hematoma: CT appearance and natural course, Radiology, Vol.258, Number3, 705-713