The value of MSCT in diagnosis of intravenous leiomyomatosis

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Purpose

Intravenous leiomyomatosis is a rare disease, also known as benign metastasizing leiomyoma, which is histologically benign but clinically aggressive. It is characterized by the intraluminal growth of leiomyomas in intrauterine and systemic veins [3].

Intravenous leiomyomatosis had some specific features in imaging findings. The lesions originated in the side of the pelvis and spread along the vessel in the direction of extension growth. The cord-like solid lesions could be detected from iliac vein to inferior vena cava and the atrium. The most useful modalities for detecting extrauterine leiomyomas are ultrasonography, computed tomography (CT), and magnetic resonance (MR) imaging. Ultrasonography can provide real-time, dynamic and multiple cross-section 2-D imaging. Combined with Doppler imaging, it has superior advantages in showing the tumor in the atrium. However, it cannot show the lesions in 3D visual. Also, the diagnosis also depends on individual experience to a great extent. And the tumor located in the heart is easily confused with myxoma. Therefore, it is restricted its use in some extent.

MR imaging is non-invasive and the most useful imaging modality for characterizing intravenous leiomyomatosis for their anatomic location and classic leiomyomas have signal intensity similar to that of smooth muscle on images obtained with any MR pulse sequence [3, 4]. Its limitations are inability to inspect the panorama of the tumors (esp. in lung) for its limited scanning range and inability to display the tumors in 3D visual in terms of poor spatial resolution.

MSCT could display the panorama of the tumors. In MSCT image, intravenous leiomyomatosis could be seen rooted from the iliac vein and extended through the inferior vena cava into the right cardiac cavities. The relationship of the tumors and associated vessels could be showed clearly. In our cases, 1 patient also had multiple rounded well-defined nodules in bilateral pulmonary, and cavitation of lesions could be seen in a nodule with MSCT. Its unusual growth patterns also called benign metastasizing leiomyoma, and metastases most often affect the lungs [3, 5, 6]. So, the advantage of MSCT is minimal invasiveness and ability to display the location and extension of the lesions and the relationship of the associated blood vessels, etc. MSCT can comprehensively discover intravenous leiomyomatosis and has high value in determining treatment plans and improving prognosis.

Intravenous leiomyomatosis consists of histologically benign, extrauterine leiomyomas, but it has malignant growth pattern that may mimic malignancies. Leiomyosarcoma has close resemblance with it. The most important entity to be considered in the differential diagnosis is leiomyosarcoma arising from the wall of the IVC [7]. But intravenous
leiomyomatosis also has close relationship with the IVC. So, it is not possible to distinguish them on the basis of imaging features alone [8]. The history of hysterectomy for leiomyoma may be suggestive of the diagnosis. Histopathologic analysis is usually required to confirm the diagnosis [3].

Successful clinical management is dependent on total surgical excision, which may necessarily include cardiotomy. It is reported that the long-term prognosis is good because the growths are hormonal [3, 9]. However, in our study, the prognoses were not satisfactory in that tumors had regressed. The tumors (3 cases) in IVC were regressed, obstructed in varying degrees and accompanied by collateral circulation. 2 cases with the subsequent development of diffuse peritoneal leiomyomatosis. These may be implicated in the subsequent development of diffuse peritoneal leiomyomatosis due to dissemination of the tumor cells along the laparoscopic tract, or the endogenous or exogenous source of hormone excess (eg, before bilateral oophorectomy) [10-12].

We present three cases of intravenous leiomyomatosis with a history of uterine leiomyoma and hysterectomy. They were found to have lesions extending through the inferior vena cava into the right cardiac cavities and confirmed to be intravenous leiomyomatosis by surgery.
A woman (36-year-old) with intravenous leiomyomatosis was recurred 3 months after surgery, and examined underwent MSCT (Fig 1-3). (Fig 1) Thin-MIP image showed the lesion rooted from the iliac vein to IVC; (Fig 2) and (Fig 3). Transverse images showed multiple rounded well-defined nodules in bilateral pulmonaries, and cavitation of lesions could be seen in some nodules; (Fig 3) The lesion also could be seen in IVC.

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Fig. 2: A woman (36-year-old) with intravenous leiomyomatosis was recurred 3 months after surgery, and examined underwent MSCT Fig1-3. Fig 1 Thin-MIP image showed the lesion rooted from the iliac vein to IVC; Fig2 and 3 Transverse images showed multiple rounded well-defined nodules in bilateral pulmonaries, and cavitation of lesions could be seen in some nodules; Fig3 The lesion also could be seen in IVC

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**Fig. 3:** A woman (36-year-old) with intravenous leiomyomatosis was recurred 3 months after surgery, and examined underwent MSCT. Fig 3 The lesion also could be seen in IVC.

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Fig. 4: A woman (39-year-old) with intravenous leiomyomatosis was recurred 3 years after surgery, and examined underwent MSCT (Fig 4-6). Fig 4 CPR image, Fig 5 VR image showed the lesion rooted from the iliac vein to IVC and looked like cords in it; Fig 6 MPR image showed diffuse peritoneal leiomyomatosis and the lesion in the iliac vein. The lesion also could be seen in IVC.

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Fig. 5: A woman (39-year-old) with intravenous leiomyomatosis was recurred 3 years after surgery, and examined underwent MSCT (Fig 4-6). Fig 4 CPR image, Fig 5 VR image showed the lesion rooted from the iliac vein to IVC and looked like cords in it; Fig 6 MPR image showed diffuse peritoneal leiomyomatosis and the lesion in the iliac vein.

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Fig. 6: A woman (39-year-old) with intravenous leiomyomatosis was recurred 3 years after surgery, and examined underwent MSCT (Fig 4-6). Fig 4 CPR image, Fig 5 VR image showed the lesion rooted from the iliac vein to IVC and looked like cords in it; Fig 6 MPR image showed diffuse peritoneal leiomyomatosis and the lesion in the iliac vein.

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**Fig. 7:** A woman (42-year-old) with intravenous leiomyomatosis. The MSCT images before treatment (Fig 7-8). Fig 7 Transverse image showed that the lumen of IVC is widened and the lesion in it; Fig 8 Sagittal image showed the lesion is shown heterogeneous enhancement, and rooted from the iliac vein extending through the inferior vena cava into the right cardiac cavities (right atrium and right ventricle); The MSCT images recurred 1 year after surgery (Fig 9-10). Fig 9 Sagittal image showed the lesion was in the iliac vein and part of IVC; Fig 10 Coronal image showed that the lesion were in the iliac vein and in the retroperitoneal and pelvic

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Fig. 8: A woman (42-year-old) with intravenous leiomyomatosis. The MSCT images before treatment (Fig 7-8). Fig 7 Transverse image showed that the lumen of IVC is widened and the lesion in it; Fig 8 Sagittal image showed the lesion is shown heterogeneous enhancement, and rooted from the iliac vein extending through the inferior vena cava into the right cardiac cavities (right atrium and right ventricle); The MSCT images recurred 1 year after surgery (Fig 9-10). Fig 9 Sagittal image showed the lesion was in the iliac vein and part of IVC; Fig 10 Coronal image showed that the lesion were in the iliac vein and in the retroperitoneal and pelvic

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Fig. 9: A woman (42-year-old) with intravenous leiomyomatosis. The MSCT images before treatment (Fig 7-8). Fig 7 Transverse image showed that the lumen of IVC is widened and the lesion in it; Fig 8 Sagittal image showed the lesion is shown heterogeneous enhancement, and rooted from the iliac vein extending through the inferior vena cava into the right cardiac cavities (right atrium and right ventricle); The MSCT images recurred 1 year after surgery (Fig 9-10). Fig 9 Sagittal image showed the lesion was in the iliac vein and part of IVC; Fig 10 Coronal image showed that the lesion were in the iliac vein and in the retroperitoneal and pelvic

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Fig. 10: A woman (42-year-old) with intravenous leiomyomatosis. The MSCT images before treatment (Fig 7-8). Fig 7 Transverse image showed that the lumen of IVC is widened and the lesion in it; Fig 8 Sagittal image showed the lesion is shown heterogeneous enhancement, and rooted from the iliac vein extending through the inferior vena cava into the right cardiac cavities (right atrium and right ventricle); The MSCT images recurred 1 year after surgery (Fig 9-10). Fig 9 Sagittal image showed the lesion was in the iliac vein and part of IVC; Fig 10 Coronal image showed that the lesion were in the iliac vein and in the retroperitoneal and pelvic

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Methods and Materials

The study was approved by the local ethics committee, and written informed consent was obtained from all patients.

Study patients

Three female patients (age 36, 39 and 40 years old) with intravenous leiomyomatosis were examined and underwent 64-slices spiral CT and treated by surgery.

CT technique

CT was performed with 64- slices CT scanner (Siemens cardiac sensation 64). The dual-phase spiral CT protocol (arterial and venous phase) was performed. 100ml of Iohexol (30g/l /100ml) was intravenously injected with a flow rate of 3-4 ml/s before examination. Arterial phase imaging was performed by using bolus tracking. Arterial phase CT data acquisition was initiated 10 seconds after the attenuation of a region of interest positioned in the aorta at the level of the celiac artery reached 120 HU. Venous phase acquisition was 50-60 seconds after the arterial phase.

CT parameters were set as follows: voltage 120 kV, tube current 160mAs, collimation 0.75mm, pitch 1, reconstruction interval 0.5 mm.

Arterial phase and venous phase images were analyzed and made for CT angiography with post-processing workstation (Volume Wizard). VR (Volume Rendering), MIP (Maximum intensity projection) and MPR (Multiple Planar Reconstructions) imagings were acquired. Two readers (C.S. and X.M.W. with 16 years and 17 years of vascular CT experience, respectively) retrospectively evaluated the data.

In the meantime, color doppler flow imaging (CDFI) were also performed. 3 patients were treated by surgery.
Results

MSCT could display the panorama of the lesions. In MSCT image, the lesions showed heterogeneous enhancement. In 3 cases the lesion could be seen rooted from the iliac vein (Fig1a, 2a-2d, 3b-3d). 2 cases showed intravenous leiomyomatosis extending through the inferior vena cava into the right cardiac cavities (Fig1a, 3b). 1 patient also had multiple rounded well-defined nodules in bilateral pulmonaries, and cavitation of lesions could be seen in some nodules (Fig 1b, 1c). Ultrasound examination could show the lesions in IVC and the right cardiac cavities (1 case that the lesion extending into the right cardiac cavities was misdiagnosed as myxoma). 3 cases were all treated by surgery. After surgery (3 months, 1 year and 3 years), all cases were recurrence. The tumors in IVC were regressed, obstructed in varying degrees and accompanied by collateral circulation (Fig 2b, 2c, 3e). 2 cases with the subsequent development of diffuse peritoneal leiomyomatosis (Fig 2d, 3d).
Conclusion

In conclusion, intravenous leiomyomatosis is a rare disease, it often extends through IVC into the right cardiac cavities, and its clinical and imaging findings have some specific features. MSCT is a valuable and necessary method in diagnosis, follow-up of it and has high value in determination of treatment plan. Though the prognoses are not all satisfactory, surgical resection is also the mainstay treatment for intravenous leiomyomatosis.
References


Personal Information

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