CONGENITAL ANOMALIES OF THE INFERIOR VENA CAVA: COMPUTED TOMOGRAPHIC FINDINGS IN NINE CASES

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Abstract: *Objective of the study: Inferior vena cava malformations are lately more often observed due to continuous development of the imaging methods. The implications of these types of anomalies are analyzed and the utility of computed tomography scan (CT) for the diagnosis is emphasized. Materials and methods: From 2010 to 2014, a number of 9 patients with IVC anomalies have been examined. All patients were examined with multiphase protocols and the data were analyzed using MPR, MIP and VRT. Results: Of the 9 patients, 3 were females and 6 were males. Age ranged between 3 weeks and 75 years old. In four cases, deep venous thrombosis was found, the other five were asyptomatic. Conclusions. The presence of recurrent deep venous thrombosis, especially in children and young adults, strongly suggests an IVC malformation. The development of collaterals could result in asymptomatic evolution.*

INTRODUCTION

Inferior vena cava (IVC) malformation represents a very diverse pathology and lately, it is more and more diagnosed because of the imaging methods improvement. Our purpose is to analyze the implications of certain types of inferior vena cava malformation based on CT findings in several cases examined in the Department of Radiology and Imaging within the University of Medicine and Pharmacy, Tîrgu-Mureş. The formation of inferior vena cava during the embryonic period, between the sixth and the eighth week, is a complex mechanism. It is developed from anastomosis between inferior cardinal veins, subcardinal and supracardinal veins. If this process fails, deficiencies occur in the formation of one or several main segments of the inferior vena cava: hepatic, suprarenal, renal and infrarenal.(1) The most common variants are: retroaortic left renal vein, double inferior vena cava, left inferior vena cava and circumaortic left renal vein.(2,3,4) There are also multiple combinations which include ayzgos vein continuation of the inferior vena cava (replacing the missing suprarenal and hepatic segments) that is often associated with cardiac congenital defects.(5)

PURPOSE

We analyse the correlation between CT findings and the symptoms of the patient.

MATERIALS AND METHODS

During a period of four years, from 2010 to 2014, we examined 9 patients with several types of inferior vena cava malformation in the Department of Radiology and Imaging within the University of Medicine and Pharmacy of Tîrgu-Mureş. The first three cases were examined with a single slice CT scanner Philips AURA and the rest of the six patients were examined with a 64MDCT scanner Siemens. The parameters for the single slice CT scanner were slice collimation of 5 mm with table feed of 7.5 mm, using 120kV and 90 mA and postreconstruction images with increments of 1.2 mm, also iv iodine containing contrast media (Iomeron 350mgI/ml) 50-90 ml with flow rate of 3ml /s. For the 64MDCT scanner, we used 120 kV and 400 mA, collimation of 64x0.6 mm with 1 mm reconstruction images. The protocols included unenhanced images and after iv contrast medium administration of 90-120 ml with flow rate of 3-4 ml/s. In these cases, we were able to analyze multiplanar reconstructions (MPR) maximum intensity projections (MIP) and 3D images (VRT- volume rendering technique). The diagnostic referral was: deep vein thrombosis of the lower limbs (four cases), renal tumour (one case), colorectal tumour (2 cases), pulmonary tromboembolism (1 case), bronchogenic carcinoma with liver metastases (1 case).

RESULTS AND DISCUSSIONS

Our patients were 3 females and 6 males. Age ranged between three weeks and 75 years old.

Table no. 1. Patient data

Age and gender	Malformed segments of IVC	Thrombosed venous segments	Collaterals	Comments
Three week old female patient	Suprarenal, renal and infrarenal segments	Left common and left external iliac veins	Ascending lumbar veins, prominent azygos and hemiazygos veins	Multiple malformation of sacral lamina vertebralis without meningocele
11-year old male patient	Suprarenal, renal and infrarenal segments	Common iliac, external iliac and femoral veins	Right perirenal, inferior epigastric veins prominent azygos vein	
34-year old male patient	Hepatic, suprarenal, renal and infrarenal segments	Common iliac, external iliac veins	Superior and inferior epigastric veins, prominent azygos and hemiazygos veins	Phleboliths in common iliac confluence
46-year old male patient	Suprarenal and infrarenal segments	Common iliac, external iliac veins	Superior and inferior epigastric veins, prominent azygos and hemiazygos veins	
44-year old male patient	Hepatic, suprarenal, infrarenal segments	Without thrombosis	Superior and inferior epigastric veins, prominent azygos and hemiazygos veins	Left renal angiomyolipoma
33-year old female	Infrarenal segment	Without thrombosis	Internal iliac and paravertebral	

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patient			collateral veins, ovarian and azygos dilated veins	
63-year old female patient	hepatic, suprarenal, renal, infrarenal segments; retroaortic left renal vein	Without thrombosis	Prominent azygos vein continues suprarenal and hepatic segments. Poor collateral network	Hepatorenal polycystic disease
61-year old male patient	hepatic, suprarenal, renal and infrarenal	Without thrombosis	Prominent azygos and hemiazygos veins, dilated paravertebral and superior epigastric veins	Phleboliths in infrarenal segment of the IVC
75-year old male patient	Double inferior vena cava with hepatic and suprailiac comunications	Without thrombosis	Without collaterals	Left bronchogenic carcinoma, liver metastases

The four cases with recurrent deep vein thrombosis of the lower limbs were: a three-week old female patient and three male patients of 11, 34 respectively 46 years of age. Contrast enhanced sequences revealed the type of malformation and filling defects in common and external iliac veins (thrombosis) (figures no. 1, 2).

Figure no. 1. Three-week old female patient, contrast enhanced maximum intensity projection (MIP) reconstruction in coronal view: lack of left femoral and external iliac vein opacification (thrombosis)

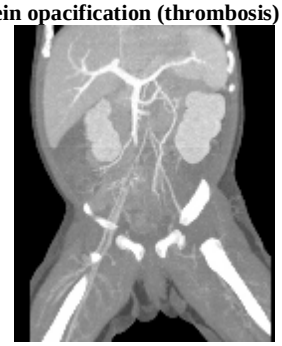
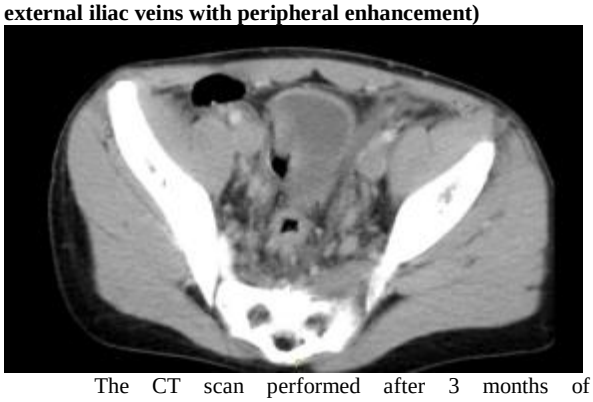


Figure no. 2. Eleven year-old boy, contrast enhanced axial view: external iliac veins thrombosis (filling defect in both external iliac veins with peripheral enhancement)



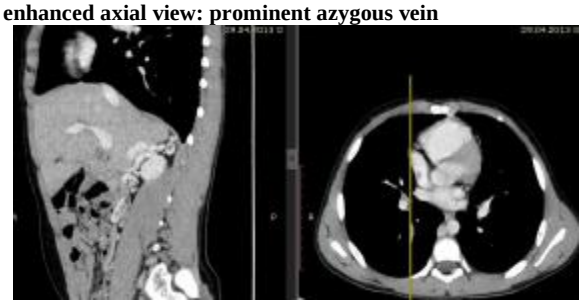
The CT scan performed after 3 months of anticoagulant therapy revealed in the 11-year old boy, the repermeabilization of the iliac and femoral veins. In the case of the 34-year old patient, a phlebolith in the confluence of the common iliac veins was noted.

Collateral development was correlated with hypoplasia severity grade consisting of multiple communications between inferior vena cava, its tributaries and azygos, respectively hemiazygos vein.

In the other five cases, the inferior vena cava malformation was an incidental finding. These patients had no history of lower limb deep vein thrombosis, but one of them had peripheral edema and varices of the lower limbs. CT scan also revealed collateral veins with paravertebral, ascending lumbar, superficial epigastric, azygos and hemiazygos dilated veins.

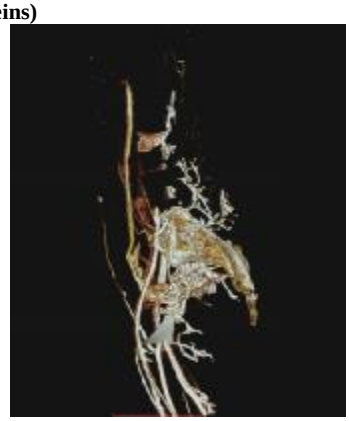
These kinds of malformation occur in 4% of general population and several studies revealed that only 0.3% of otherwise healthy individuals show malformation of inferior vena cava.(5,7) In our study, only four patients had a history of deep vein thrombosis, in the other five patients, the malformation was an incidental finding. In the two pediatric cases with deep vein thrombosis, the three-week old girl showed a poor development of collaterals, on the contrary, the eleven year-old boy presented a rich development of collaterals in the perirenal, ascending lumbar, paravertebral and superficial epigastric territories caused by the long-lasting iliocaval thrombosis (figure no. 3-left).

Figure no. 3. Same patient as in figure no. 2: *left,* contrast enhanced multiplanar reconstruction (MPR) sagittal view – multiple hepato-renal collateral veins; *right,* contrast enhanced axial view: prominent azygous vein



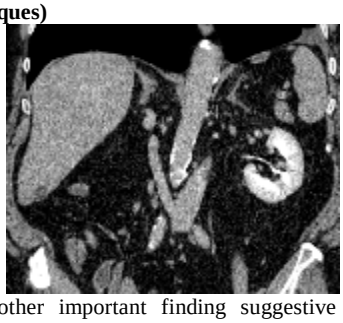
The way the contrast media was administrated has proven to be very important in the depiction of the venous return in collaterals. Consequently, in the thirty three-year old female patient, the contrast media was given through double catheterization of the superficial veins in both lower limbs. That is why we could observe the early and intense collateral network enhancing in paravertebral, internal iliac and ovarian dilated veins with poor opacification of the malformed infrarenal segment of the inferior vena cava (figure no. 4).

Figure no. 4. 33-year old female patient, 3D image - volume rendering technique (VRT), opacified veins (ascending lumbar, ovarian, paravertebral, internal iliac dilated collateral veins)



In a seventy-five-year old male patient with lung carcinoma, an IVC malformation was discovered which consisted of a right hypoplastic IVC and a left paraaortic IVC with double communication between them (right above iliac confluence and suprarenal) (figure no. 5).

Figure no. 5. 75-year old male patient with lung carcinoma and liver metastases, with an incidental finding of a double IVC – CECT MPR coronal view depicts the fusion between the two IVC (abdominal aorta between them with multiple calcified plaques)



Another important finding suggestive for an IVC malformation is the prominence of azygous and hemiazygous veins (6) (figure no. 3-right).

The hypothesis of hypercoagulable state associated with inferior vena cava malformation is sustained by the significant percentage (44.82%) of patients with positive markers for thrombophilia.(7) On the other hand, some authors claim that slowing of venous flow in malformed segments represents the main cause of venous thrombosis without disturbances of blood coagulation.(8,9) These patients need long-lasting anticoagulant therapy with good results.(9)

CONCLUSIONS

In patients with recurrent deep vein thrombosis of the lower limbs, there is a strong possibility of inferior vena cava malformation especially in children and young adults. On the other hand, the development of rich collaterals could determine an asymptomatic evolution of this condition, often being an incidental finding.

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