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PRIMARY AORTIC THROMBOSIS: ROLE OF ENHANCED MULTISLICE CT DEMONSTRATED IN THREE EXCEPTIONAL CASES

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Primary aortic thrombosis remains a rare entity that can be defined as clotting of the vessel without any obvious atheromatous lesion.
Cancer chemotherapy, cocaine intake, essential thrombocythemia, some hypercoagulable states, heparin-induced thrombocytopenia, inflammatory disease of the digestive tract and acute pancreatitis are, beside some cases of rather unknown etiology, the causes of primary aortic thrombosis.
Intravenous contrast-enhanced multislice CT, which is widely available, noninvasive and affordable in terms of cost, is the imaging modality of choice for the investigation of primary aortic thrombosis and the assessment of potential complications. Three cases due to chemotherapy, antiphospholipid syndrome and acute pancreatitis are reported.

Key-word: Thrombosis, arterial.

Primary aortic thrombosis (PAT) is described as an aortic thrombosis occurring without an underlying atheromatosis or, at least, without any obvious concomitant atheromatous lesion.

Intravenous contrast-enhanced multislice computed tomography (MSCT) is the imaging modality of choice to investigate the disorder as it is widely available, noninvasive and relatively cheap and can identify the extension of the thrombi in a perfect way and enable evaluation of the possible complications that are mainly of ischemic nature.

Cancer chemotherapy, cocaine intake, essential thrombocythemia, some hypercoagulable states and heparin-induced thrombocytopenia may lead to PAT. Moreover, inflammatory diseases of the digestive tract and acute episodes of pancreatitis can also induce a primary thrombosis of the aorta. We present three of these exceptional cases.

Case reports

Case 1

A 54-year-old man is referred to our Radiology Department for assessment of gastric adenocarcinoma. Contrast-enhanced MSCT shows a T4b, N2, M1 tumor stage and a normal infrarenal abdominal aorta (Fig. 1A).

MSCT follow-up during 5-fluorouracile chemotherapy reveals worsening of the neoplastic disease and demonstrate the emergence of a primary partial mural clotting of the infrarenal abdominal aorta (Fig. 1B). As a consequence of the incomplete nature of the thrombus, the patient remains asymptomatic. He is treated with subcutaneous heparin injections.

A low dose intravenous contrast-enhanced MSCT two months later displays further tumor expansion; nevertheless, the aortic mural clot has disappeared (Fig. 1C).

Case 2

A 27-year-old woman is admitted to our Emergency Department for abdominal pain. Clinical examination reveals a sensitive abdomen without guarding. Her laboratory data show a white blood cells count of 22.9 G/L (normal values: 3.9-10.2 G/L), a C-reactive protein at 400 mg/L (normal values: < 5 mg/L) and a lactate dehydrogenase at 339 U/L (normal values: 135-214 U/L); her creatinine and her estimated glomerular filtration rate remain normal.

MSCT is performed in normal radiation dose, without and with intravenous contrast material. It displays a segmental thrombosis of the superior mesenteric artery (Fig. 2A) and, as a consequence, sub-ischemia of some slightly thickened small bowel walls which demonstrate late enhancement (Fig. 2B). There is no associated ostial dissection of the artery.

Transthoracic echography is negative and on the next day thoracic MSCT examination is performed. It demonstrates a mural polypoid thrombus of the non atheromatous descending aorta (Fig. 3), probably the cause of the segmental mesenteric arterial thrombosis. The patient is treated successfully by intravenous heparin soon followed by vitamin K antagonist. A specialized laboratory test reveals an antiphospholipid antibody rate of 50 U/L, which is confirmed by a second test six weeks later. An antiphospholipid antibody syndrome complicated by PAT is finally diagnosed.

A final MSCT angiography is carried out 12 weeks after the initial episode and visualizes the resorption of the aortic (Fig. 4A) and arterial mesenteric clots (Fig. 4B). The small bowel loops have normalized radiographically.

Case 3

A 50-year-old lady presents to our Emergency Department with intense epigastric pain. Clinical examination demonstrates abdominal guarding. Results of laboratory tests show: white cell count 12.9 G/L (normal values: 3.9-10.2 G/L), C-reactive protein at 144 mg/L (normal values: < 5 mg/L), amylase at 1222 U/L (normal values: 13-53 U/L) and lipase at 2257 U/L (normal values: 13-60 U/L); her creatinine and her estimated glomerular filtration rate are normal. An MSCT assessment is ordered and is performed under a normal radiation dose without and with intravenous injection of contrast material. It discloses a severe pancreatitis with a Balthazar severity index of 10, due to multiple periglandular effusions and to more than 50% of pancreatic necrosis (Fig. 5A).

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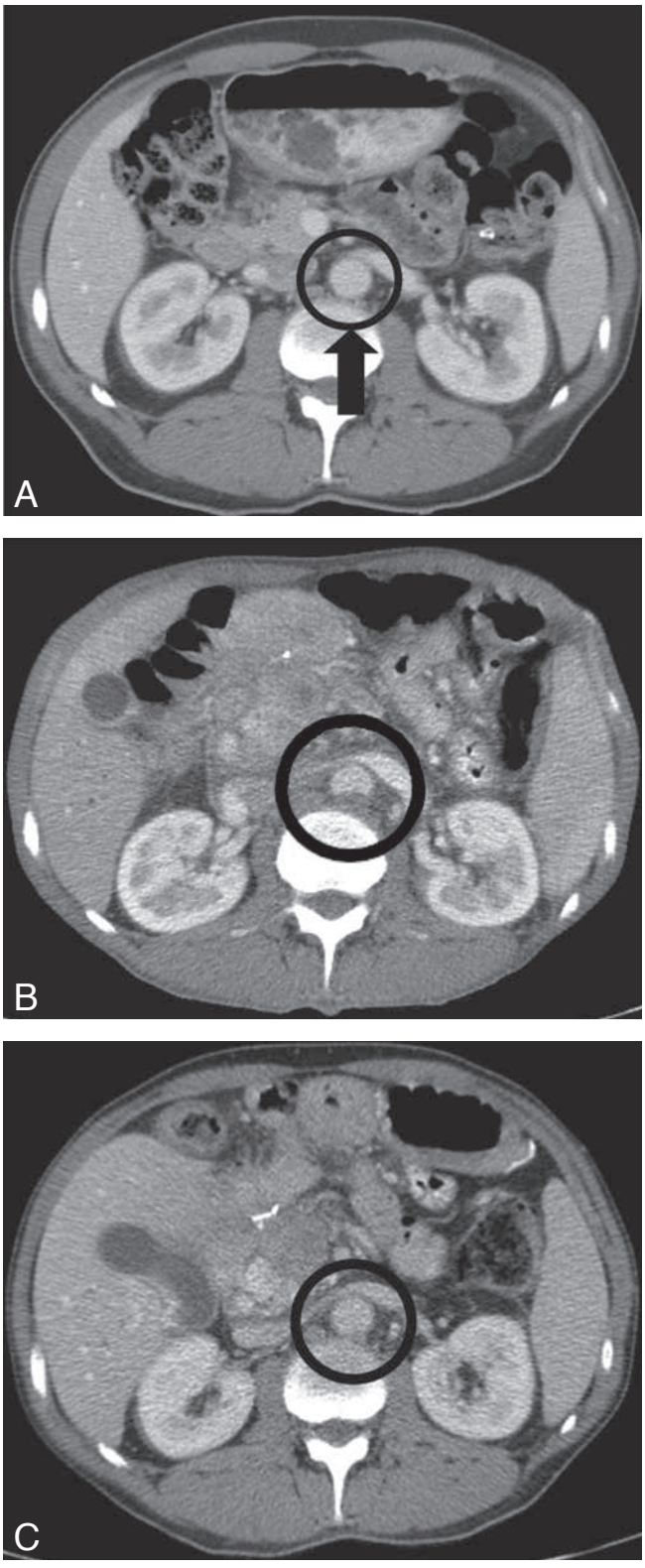


Fig. 1. — A. Enhanced MSCT: the non atheromatous abdominal aorta is free (black circle and arrow) where it crosses the left renal vein. B. Low dose enhanced MSCT, at the same level as A, during chemotherapy: emergence of a mural thrombus (red circle). C. Low dose enhanced MSCT (same level as A and B): disappearance of the thrombus (black circle) after proper anticoagulation.

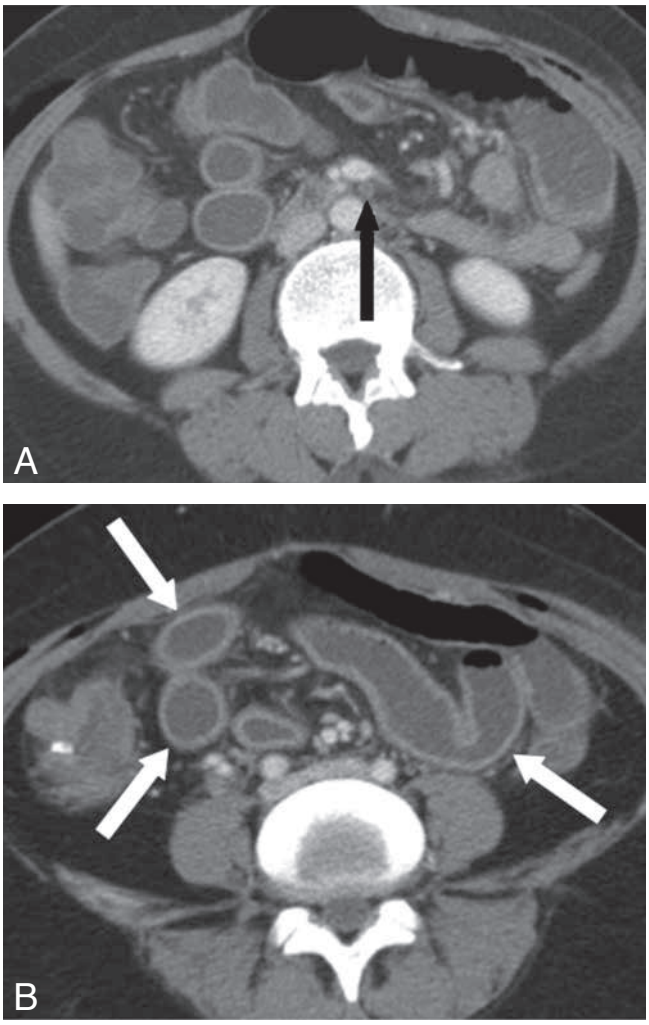


Fig. 2. — A: Enhanced MSCT: segmental thrombosis of the superior mesenteric artery (red arrow). B: The suffering of some small bowel loops which are thickened and demonstrate delayed enhancement (arrows).

In addition to the pancreatic damage, MSCT demonstrates several partially obstructive endoluminal gaps at the level of the infrarenal abdominal aorta. They reveal partial primary clotting on a vessel which is only slightly atheromatous (Fig. 5B). The partial nature of thrombosis explains the lack of ischemic symptomatology at the level of the lower limbs. A standard treatment of acute pancreatitis is started, coupled with intravenous heparinotherapy, followed by subcutaneous heparin ten days later. Control enhanced MSCT is performed three weeks later with a normal radiation dose considering the patient's elevated body mass index. Progressive regression of the pancreatic lesions is confirmed and resolution of the lower aortic clotting

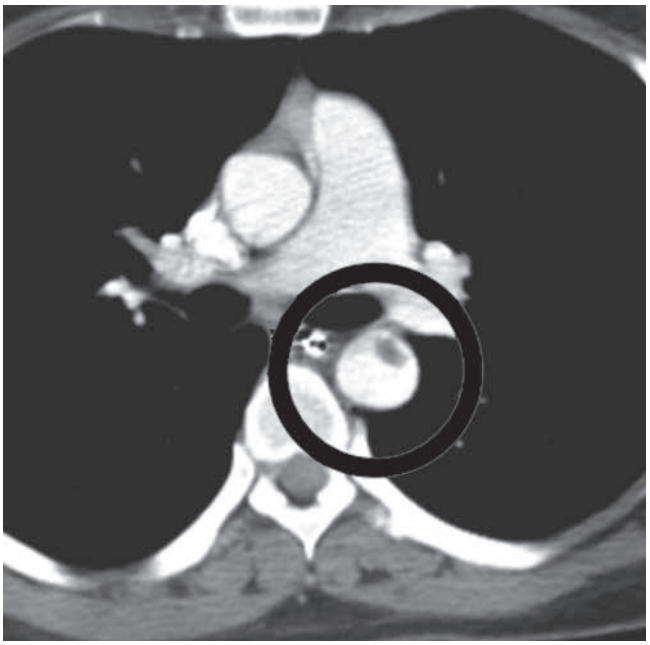


Fig. 3. — Enhanced MSCT: the mural thrombus of the non atheromatous descending aorta (red circle), figurative of PAT.

is also shown (Fig. 5C), which proves a PAT attributable to an acute episode of pancreatitis.

Discussion

In 1958, H.Gaylis described the first cases of PAT without any underlying atheromatous lesion. Few techniques were available at that time to identify their origin and the etiologies remained rather vague (1).

Medical Sciences will evolve fast and, despite the rarity of PAT, the range of etiologies will broaden progressively. They comprise nowadays cancer chemotherapies, essentially cisplatin-based ones (2-4), cocaine intake (5, 6), essential thrombocythemias (7, 8), some hypercoagulable states such as the antiphospholipid antibody syndrome or homocysteinemia (9, 11) and heparin-induced thrombocytopenias (9, 12). They also comprise inflammatory lesions of the digestive tract like Crohn's disease (9, 13) or ulcerative rectocolitis (14). Finally, PAT can also occur during an episode of acute pancreatitis (9, 15).

A diagnosis of aortic thrombosis can be achieved by MRI, by digitalized angiography or by transesophageal echography in case of thoracic localization, but MSCT is the initial investigation of choice (2-6, 9, 12-15). The equipment is widely available and the examination is neither very expensive nor really invasive. Ideally, it will be performed after intravenous injection of iodinated contrast material, which enables the detection of thrombi, even the smallest ones, which are characterized by areas of endoluminal non opacification. A lack of intravenous opacification might hide the range of possible complications, mainly ischemic ones, whose clinical diagnosis is difficult, and that are suggested by an unexplained deterioration of the vital and biological parameters (16). These necrotic phenomena which are possibly associated with aortic thrombosis can, of course, vary depending on the topography and the extent of the thrombi. Nevertheless, contrast enhanced MSCT is able to identify them quite easily, whether they are cerebral, cardiac or digestive in localization, assessment of the damage to the limbs falling quite evidently into the clinical domain. Finally, intravenous contrast-injected MSCT enables the detection, or even the staging of a possible causal lesion of the PAT, i.e. an inflammatory disease of the digestive tract or an acute pancreatitis.

Any neoplastic syndrome is accompanied by an exacerbation of thromboembolic events. Numerous complex mechanisms are put forward, including, but not limited to,

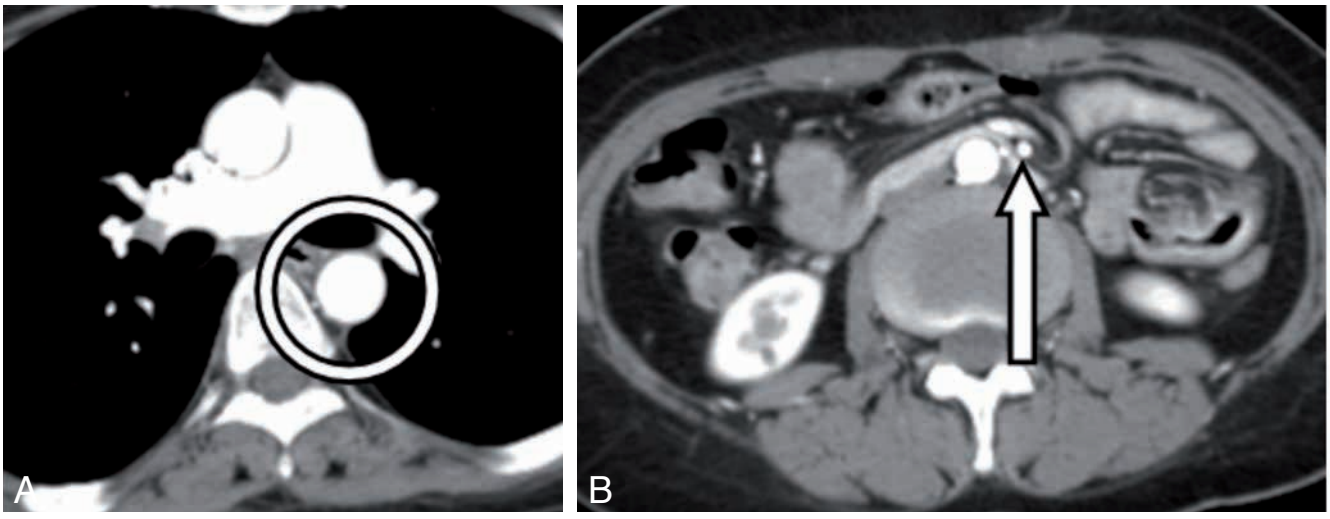
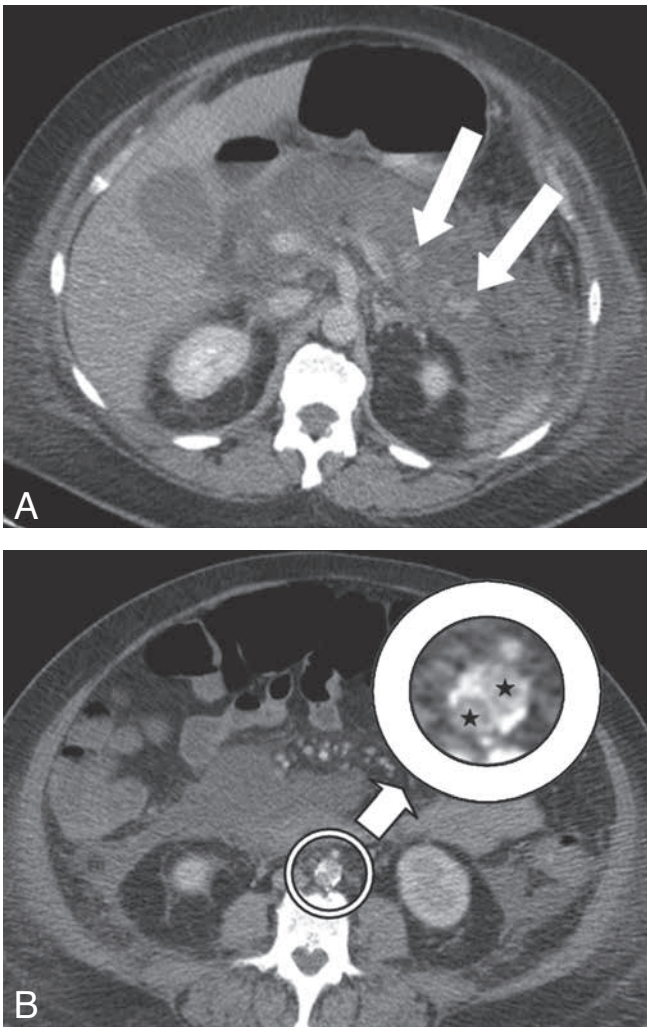


Fig. 4. — A,B: Enhanced MSCT after anticoagulation therapy: complete resorption of the aortic (circle) and mesenteric (arrow) clots.



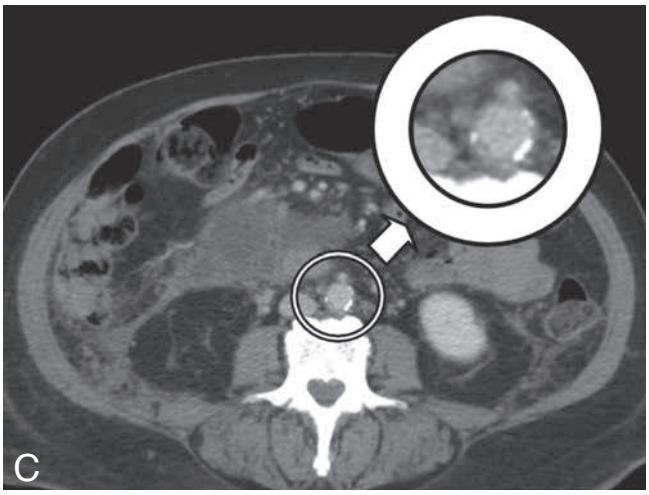


Fig. 5. — A: enhanced MSCT: severe pancreatitis, with a Balthazar severity index of 10, due to multiple fluid effusions and scarce residual pancreatic tissue spared by necrosis (arrows). The splenic vein is partially thrombosed. B: Enhanced MSCT at the level of the infrarenal aorta showing the incomplete thrombosis of the vessel (black stars, in the zooming white circle) which is only slightly atheromatous. C. Enhanced MSCT, same level as B, after 3 weeks of anticoagulation: disappearance of the clotting (thick white circle).

endothelial damage, alterations of the clotting cascade, stimulation of fibroblasts, hypomagnesemia or disturbances of the left ventricular function (2, 4). The thromboembolic risk is further increased in case of addiction to smoking, preexisting atheromatosis, in the presence of liver metastases or in case of concomitant antiemetic therapy with dexamethasone (2, 4). Moreover, the type of cancer disease, i.e. adenocarcinomas, also exacerbates thromboembolic events (4). Finally, the risk increases up to six times in case of cancer chemotherapy and mainly when cisplatin is administered (2, 4). This drug is considered to cause the 20% of venous thromboses and the 2% of the arterial, namely aortic, clottings (cf. case report 1) that arise in patients under treatment (4). The thromboembolic episode occurs essentially within some days up to some weeks after injections are started (4). It appears under extremely various forms, from absolutely asymptomatic cases up to the most serious clinical presentations. Considering the severity of the case, the therapy will range from heparin-based anticoagulation to thrombolysis, via surgery or even the implantation of endovascular stent grafts (2-4, 14). To date, no evidence-based preventive treatment for thromboembolic events in case of cisplatin-based chemotherapy is known, therefore radiologists must be particularly vigilant for these high-risk patients (4).

Cocaine consumption induces vasospastic and thrombotic phenomena that are dose-related (5). If the vasospasms are triggered by the release of catecholamines due to sodium channels blockade (6), the thromboses arise because cocaine decreases the C protein and antithrombin III levels, increases the plasminogen activator inhibitor and activates the blood platelets (5). Via these mechanisms the drug will cause cerebral ischemias, arrhythmias, myocardial infarctions, venous thromboses and also thrombotic occlusions of the mesenteric and renal arteries (5). It can also, though much less often, be the cause of PAT (5, 6) that will be ideally demonstrated by MSCT, a procedure that evaluates perfectly not only the aortic thrombi but also the possible spread of clotting in the aortic branches and its potential complications. The treatment of cocaine-induced PAT will vary, depending on the extent of the thrombosis and its possible ischemic consequences, from heparin therapy to open surgery for the most severe cases (5, 6).

Essential thrombocythemia too, a myeloproliferative syndrome, is also associated with PAT. If it is complicated by hemorrhages when the number of blood platelets explodes, it is generally responsible for arterial thrombotic events, namely of aortic topography (7). The therapy for essential thrombocythemia weighs up the patients' age and their risk factors as well as the degree of elevation of the blood platelet count. It ranges from supportive care to chemotherapy and includes, quite evidently, the treatment of thrombohemorrhagic episodes (8).

Some hypercoagulable states can be complicated with PAT too. The antiphospholipid antibody syndrome is a primary or secondary autoimmune disease (e.g. associated with systemic lupus erythematosus) where the patient produces circulating antibodies attacking the phospholipids, which results in an alteration of the cell membranes, an

activation of the prothrombin and of the blood platelets. Since other antibodies also inhibit C or S protein and antithrombin III, venous and arterial thrombotic events, namely of aortic topography, follow that can be perfectly demonstrated by MSCT (cf. case report 2). The diagnosis of antiphospholipid antibody syndrome takes place in the laboratory and it must be noted that 2% of the population are carriers of the antibodies without developing the syndrome. In these cases the production of antibodies is transitory and can be generated, for example, by a myoplasma infectious episode (9, 11). The contribution of other hypercoagulable states, i.e. C or S protein or even antithrombin III deficiencies, to arterial thromboses remains controversial whereas homocysteinemia, another thrombophilic state, is known to favour the formation of clots in the arteries (10). Hypercoagulable states therapy must consider their possible causes and the prevention or cure of thromboembolic events (heparin, vitamin K antagonists, even antiplatelet drugs).

Heparin-induced thrombocytopenia is another possible cause of PAT. Whether the drug is injected intravenously or subcutaneously, it promotes the formation of antibodies that cause the blood platelets to aggregate, hence a thrombocytopenia due to the formation of peculiar arterial platelet thrombi called white clots (9, 10, 12). Heparin-induced thrombocytopenia is diagnosed on basis of clinical factors and on laboratory testing (12). It will be treated by stopping heparin and replacing it, even by treating the possible clottings as well as their possible complications.

Some inflammatory enterocolites, i.e. Crohn's disease (9, 13) and ulcerous colitis, can also cause a PAT. Though all their etiopathological mechanisms are still unknown, they probably happen along alterations of the coagulation cascade and an activation of the blood platelets (13). Their therapy combines the one for the causal pathology with that of arterial thrombosis.

Finally, PAT can also be secondary to an episode of acute pancreatitis (9, 15). Next to the fact that a severe inflammation of the pancreas releases proteolytic enzymes that will cause direct vascular damage due to erosion with subsequent hemorrhages (16, 17), it also provokes, via the release of trypsin, an activation of thrombogenic factors such as, among others, fibrinogen and blood platelets (16). Since it can also induce hypovolemia, stasis and vascular spasms will follow, at frequencies that can reach respectively 45% and 1%, venous and arterial thromboses, the latter occurring most often proximal to the inflamed pancreas, but even distal to it as in our case report 3 (16). Depending on their more or less obstructive nature, these arterial thromboses can induce ischemias which will first maintain the acute pancreatitis (16) but which will also cause distal tissue necroses with potential cerebral, myocardiac, digestive wall or limb lesions (16, 17). It has already been said, but let us stress again that these complications, whose clinical diagnosis proves difficult, are suggested by an unexplained deterioration of the vital and biological parameters, and can be perfectly demonstrated by MSCT (16, 17). The therapies are as variable as the damages caused by arterial clotting: they range from simple watchful waiting to open surgery via the techniques of interventional radiology without neglecting of course the treatment of the causal pancreatitis (2-4, 9, 14).

Conclusion

Radiologists should keep in mind that PAT, even if it is a rare entity, can complicate a whole series of clinical conditions such as cancer chemotherapies, cocaine intake, essential thrombocythemias, some hypercoagulable states and heparin-induced thrombocythopenias. Some inflammatory diseases of the digestive tract and acute pancreatitis can also induce a primary thrombosis of the aorta with sometimes devastating consequences.

Contrast enhanced MSCT is easily available, almost noninvasive and relatively affordable. It is the imaging procedure of choice in the exhaustive detection of aortic clottings and their possible causes as well as in the evaluation of their potential complications, paving the way to the relevant therapy.

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