

evaluation of CT factors of transplantectomy in pancreatic graft trombosis : proposal of a radiological reading table

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Aims and objectives

Pancreatic transplantation is currently the gold standard for the restoration of the endocrine function (1).

The simultaneous pancreas-kidney transplant (SPK) is currently considered as the best pre-terminal renal disease treatment for type 1 diabetic patients aged up to 55 and represents the main indication of pancreatic graft. Literature data show constant improvement of patient and graft survival, as well as the superiority of this combined transplant to dialysis or to single kidney transplant, particularly regarding the long-term complications of diabetes (2-6).

Despite important advances in the selection of recipients and donors, surgical techniques and post-operative treatment, the rate of post-surgical complications remains high compared to other solid organ transplants. Namely, 8 to 9% of early graft failures are registered on an international scale versus 10 to 15 % in France. 30% of patients require post-transplant relaparotomy (7-9). Graft loss clinically implies resuming insulinotherapy. It may have an immunological origin, but early graft failure is mainly related to vascular thrombotic complications (3). Despite an appropriate medical treatment, these thrombotic complications unfortunately often end in transplantectomy, which means ultimate graft loss. (10).

Computed tomography (CT) has shown its superiority to other imaging techniques in the understanding of anatomy and the visualization of complications following pancreas transplant, including thrombosis (11,12) (**Fig 1**).

The purpose of our study is to search prognostic factors of transplantectomy in a pancreatic transplant population who had early vascular thrombotic complications.

Images for this section:

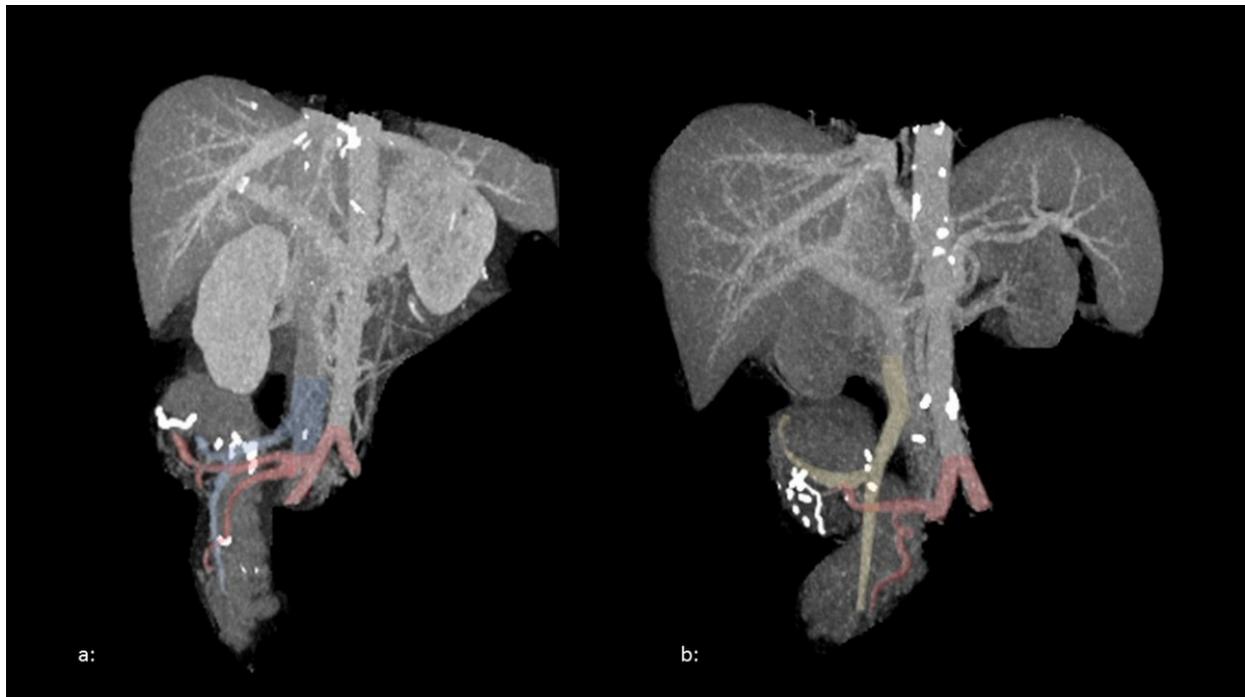


Fig. 1: Figure 1: CT visualization of surgical assembly. Coronal reconstructions in MIP 3 dimensional of a pancreas transplanted with (a) systemic venous drainage and (b) portal venous drainage. Red color represents arterial supply from the native primitive iliac artery, blue color represents venous drainage to the native inferior vena cava, and the color yellow venous drainage into the native portal vein.

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Methods and materials

- Population:

This is a retrospective study of the whole population who underwent a pancreas transplantation in our University centre, from April 2007 to December 2015. 77 pancreatic transplants were conducted during this period.

The study of the clinico-radiological records included a total of 28 patients with early vascular thrombosis within the first month following transplantation.

Distal thrombosis of the pancreatic vessel transected margin or of the mesenteric artery stump or a margined thrombus with no reduction of the vessel lumen have been considered criteria of exclusion (**Fig 2**).

Therefore, we have retained 18 patients with significant thrombotic complications.

In this population of pancreatic transplanted patients with thrombotic complications, we compared the group of patients (**group T**) who underwent early graft failure entailing a transplantectomy to the other group (**group NT**) whose vascular complication did not entail transplantectomy or graft loss to 3 months.

It should be noted that all patients received an appropriate treatment through revision surgery for thrombectomy and/or curative anticoagulation.

- Imaging technique

All imaging examinations mentioned in our study were made on requests of clinicians, on a suspicion of post-transplant complications.

The CT examinations performed in our Center for this population were all made on a 64-detector scanner (SIEMENS SOMATOM® Definition Scanner 64 Erlangen, Germany). The acquisition parameters were as follow: Acquisition scope: 150 cm; section: 2mm thickness; reconstruction interval: 1 mm; 120 kV, 280 mA; noise index: 15.

The acquisition protocol was triphasic covering the entire abdominal-pelvis:

-acquisition without injection.

-acquisition after injection of iodine contrast medium at arterial time with setting of an automatic detection ROI in the abdominal aorta.

-acquisition at 80 seconds after injection of iodine contrast agent.

- Epidemiological analysis:

We compared the global epidemiological data between T and NT groups.

Secondarily, we compared the lapses of time in vascular thrombotic complication occurrences in T and NT groups respectively.

- Radiological analysis:

The imaging analysis was concomitantly conducted by two radiologists, blinded to patient status (transplantectomised or not).

For each patient with thrombotic complication, we studied the following radiological criteria:

1: the percentage of pancreatic necrosis : visually graded according to a semi-quantitative scale of 4 categories based on the enhancement (0%, <50%, >50%, 100%). These categories were chosen to simplify classification in common practice.

2: the number of thrombosed vessels: The selected vessels were the mesenteric superior artery and vein (**SMA and SMV**), the splenic artery and vein (**SA and SV**).

3: Arterial and/or venous location of the thrombus.

4: the completeness of thrombosis : we distinguished cases of complete occlusion of the vessel lumen from those where the thrombosis was partial.

- Statistics:

For each quantitative variable a Shapiro-Wilk test was used in order to determine if our samples followed a normal distribution. Depending on this setting, we compared the epidemiological data of both groups, either with a Student test or with a Mann-Whitney test. We compared both groups with a Fisher test regarding the proportion of arterial and venous thrombi as well as the complete or partial status of the thrombosis. We compared the percentage differences in pancreatic graft enhancement with a χ^2 test. We used a Spearman correlation coefficient and built a ROC curve to analyze the relationship between the number of pancreatic vessels and transplantectomy. We compared the scanner completion times with a Mann-Whitney test. A difference was considered significant if $p < 0.05$. The statistical software used was MedCalc 17.4 version (MedCalc Software, Ostend, Belgium).

Images for this section:

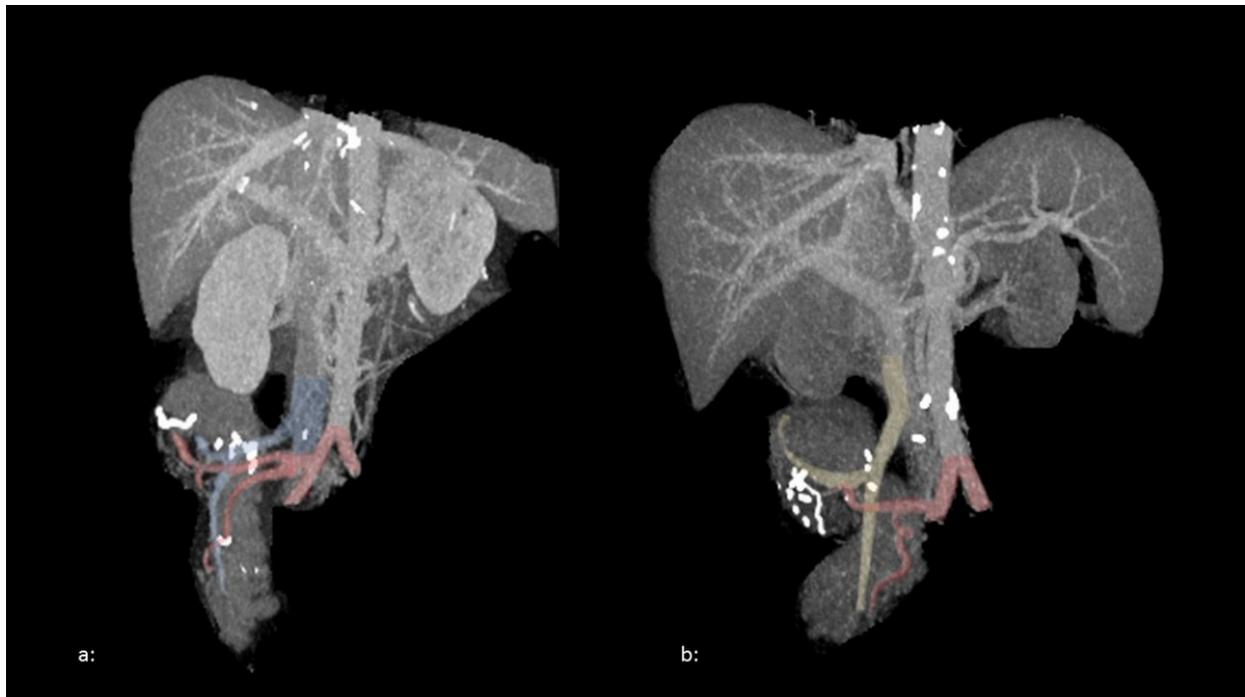


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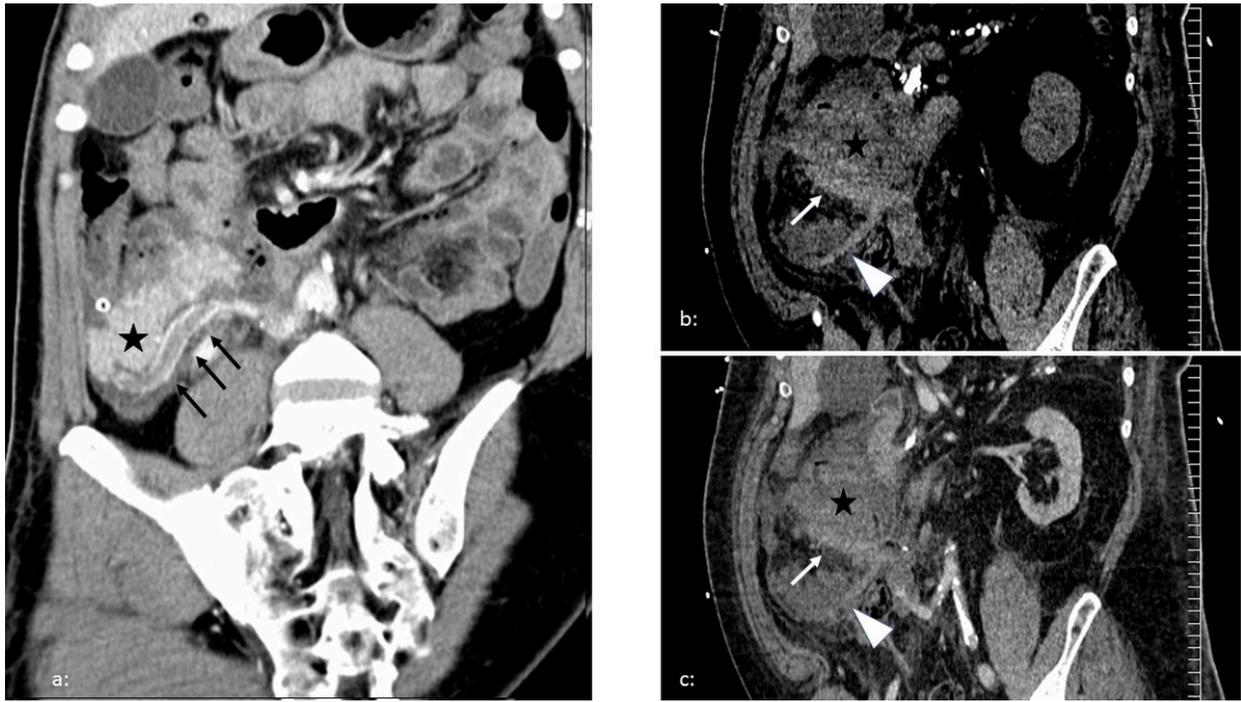


Fig. 2: Figure 2: Margined thrombus and SMA stump a: oblique sagittal MPR, showing a margined thrombus of the pancreatic graft splenic vein (black arrows) without any reduction of the vessel lumen. b: MIP coronal reconstruction showing a thrombus at the stump of the mesenteric artery of the pancreatic graft (black arrow), after the end of the inferior pancreatico-duodenal artery (black arrow head). The black star represents the pancreatic parenchyma, enhanced.

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Results

1. Population:

a. Epidemiological data:

Among the 77 pancreatic transplanted patients in our Center, 18 presented significant thrombotic vascular complications. Thus the percentage of vascular complication on the overall transplanted population is 23.37%. Group T includes 8 patients (9.1% of the total number of pancreatic transplanted patients) and group NT includes 10 patients.

Comparison of T and NT groups highlighted a significant difference regarding cold ischaemia time, which was higher in group T ($p = 0.0308$). There is also a non-significant trend regarding the recipients' BMI, which was more important in group T. At last, 6 patients in the NT group were dialysed while only 1 in the T group ($p = 0.0656$).

b. CT time:

The CT examinations have been conducted in 16 patients on clinical or biological suspicion of thrombosis: abdominal pain, deglobulisation, rise in blood glucose or C-peptide.

In group T, the median time between transplantation and CT examination was 3 days, the period going from 1 to 19 days (standard deviation = 6). However, 7 out of 8 patients were transplantectomised within the first 5 days after transplant.

In the NT group, the median time between transplantation and CT examination was 8 days, with a significant dispersion of measures ranging from 4 to 20 days (standard deviation = 5).

Figure 5 represents the thrombosis occurrence for each group. The risk of transplectomy is all the more important that thrombosis is diagnosed early. The very early occurrence of thrombotic complications is more likely to lead to transplantectomy ($p = 0.0162$).

2. Radiological analysis:

All the CT examinations were of good quality and interpretable as regards the criteria to be studied. Both readers' radiological findings were concordant.

a) Pancreatic enhancement (table 1) (fig 4):

A significant difference in percentage of pancreatic parenchyma enhancement between the two groups ($p = 0,0239$) has been highlighted. All the patients who presented a complete necrosis of the pancreatic gland had been transplantectomised ($n = 4$ vs 0); on the other hand we noted the same number of grafts without any enhancement anomaly (0%) in both groups ($n = 2$ vs 2).

b) Number of vessels damaged involved

The number of vessels affected is significantly higher in group T with an average of 1.1 vs 3.1 in group NT ($p = 0,0005$). In addition, the study of the correlation between the number of vascular segments involved and transplantectomy shows a significant correlation between the number of vessels involved and the occurrence of a transplantectomy ($\rho = 0,89$; $p < 0.0001$). The presence of at least 3 vessels involved predicts the occurrence of a transplantectomy with a 100% specificity and a 62% sensitivity. The area under the ROC curve is 0.98 (**fig 5**).

c) Thrombus location (table 2):

In group T, arterial involvement occurs in 87.5% of cases and venous involvement in 87.5% of cases. In the NT group, only a single arterial involvement is listed (10% of cases), against venous involvement in 90% of cases.

This result shows a significant association between artery involvement, and transplantectomy ($p = 0,0028$), whereas there is no significant difference between the groups as regards venous involvement ($p = 1$).

d) Thrombosis characterization (Fig 6):

We have pointed out a significant association between complete thrombosis of a vessel (arterial or venous) and the occurrence of transplantectomy ($p = 0.0008$).

All the patients in group T had at least a complete thrombosis of a vessel, while in the NT group one patient only displayed a complete thrombosis. The results also show that 100% of the patients who had partial thrombosis only were able to avoid transplantectomy (**Fig 7**).

Images for this section:

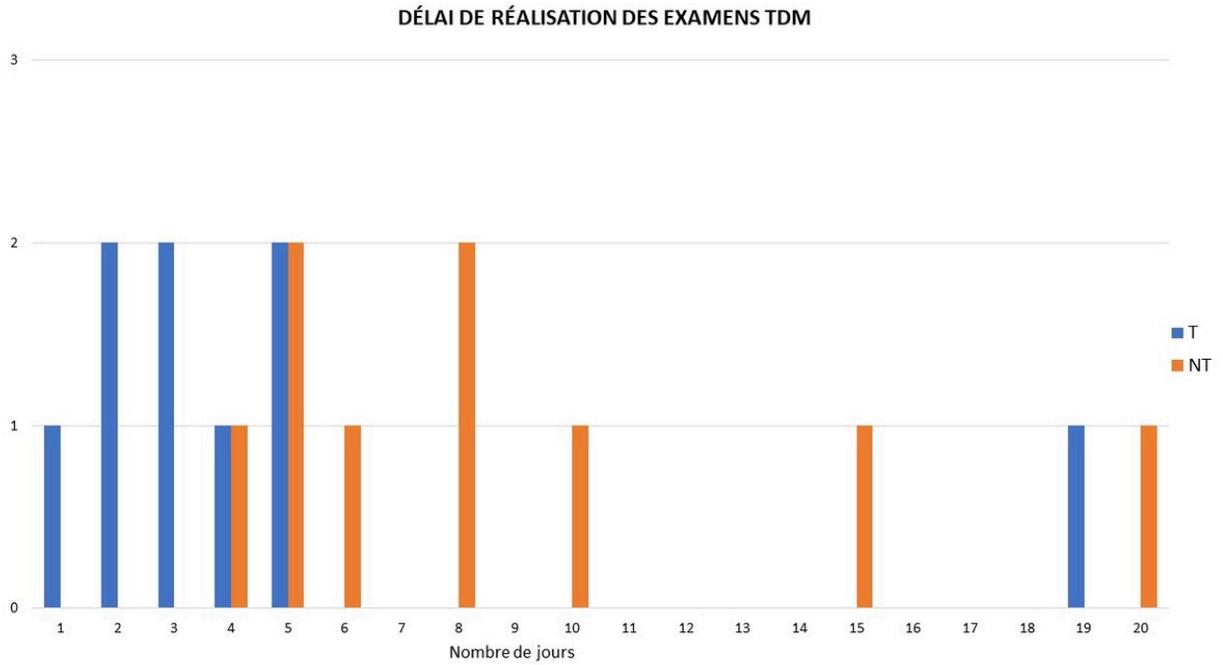


Fig. 3: curve of CT examination completion times for the two groups studied. Abbreviations: T = Transplantectomised group NT = Non-transplantectomised group

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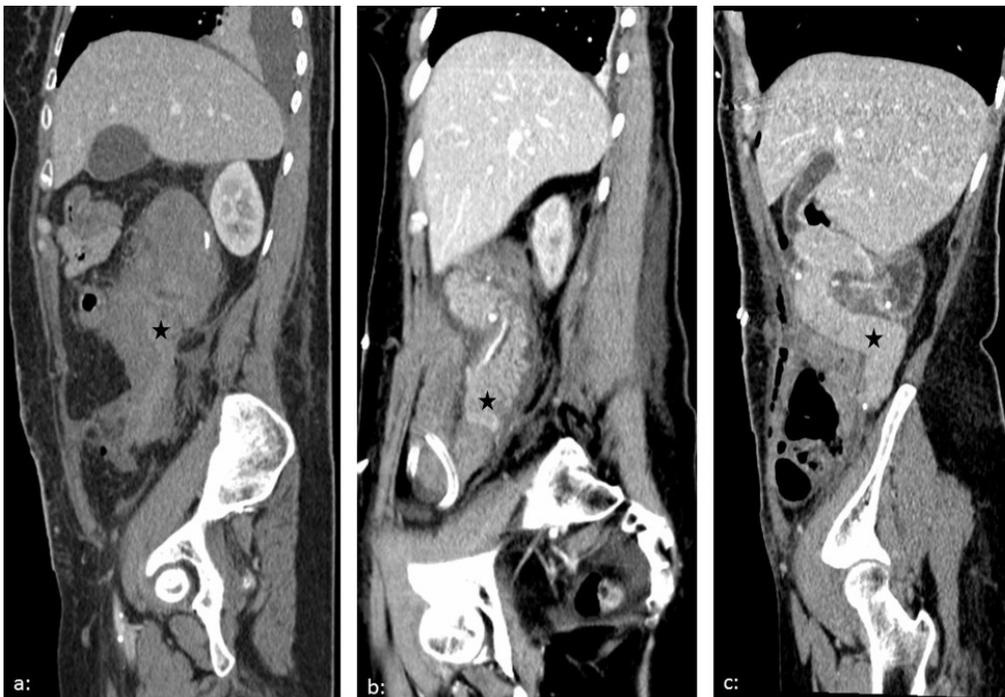


Fig. 4: Pancreatic enhancement : MPR CT reconstructions in oblique sagittal section through the pancreatic transplant parenchyma plane (black star), with: (a) total failure in parenchyma enhancement, (b) default of parenchyma enhancement inferior to 50%, (c) lack of anomaly in parenchyma enhancement.

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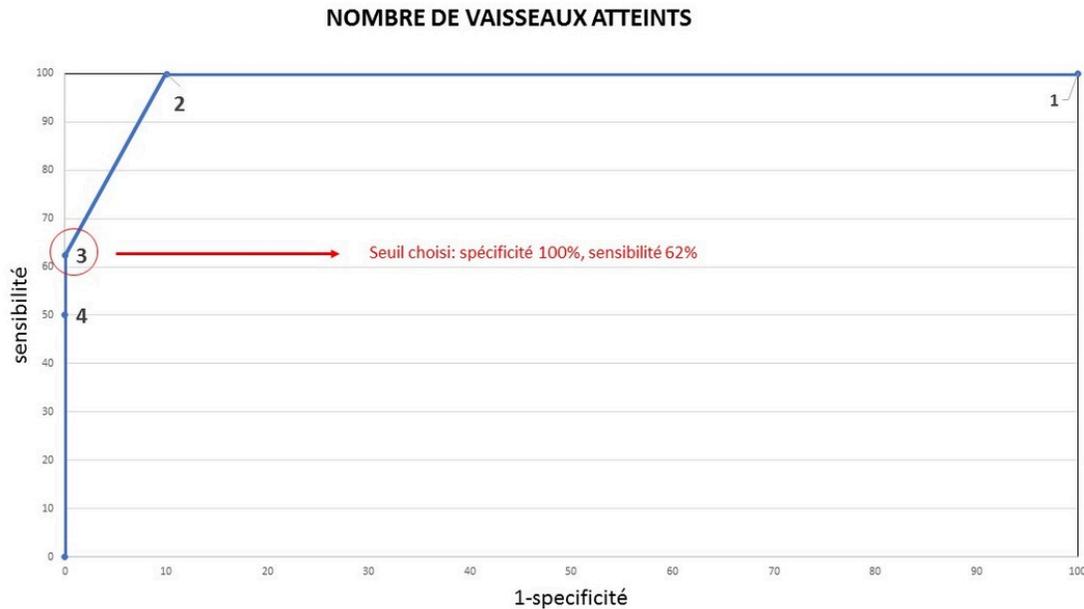


Fig. 5: ROC curve representing the correlation between the number of vessels involved and the occurrence of complications.

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	Pourcentage of enhancement failure			
	0%	<50%	>50%	100%
Group T (n)	2	2	0	4
Group NT (n)	2	8	0	0

Table 1: Percentage of pancreatic enhancement failure in the T and NT groups
Abbreviations: T = transplantectomised, NT = non-transplantectomised.

	T (n=25)	NT (n=11)
MA	6	1
MV	6	2
SA	6	0
SV	7	8

Table 2: Thrombus location in T and NT groups Abbreviations: T = transplantectomised, NT = non-transplanctectomised, MA = mesenteric artery, MV = mesenteric vein, SA = splenic artery, SV = splenic vein



Fig. 6: Complete or partial thrombosis : MPR reconstructions of two patients CT in the pancreatic graft plane (black star) with left (a) the visualization of a partial thrombosis of the splenic vein of the pancreatic graft (black arrows) and right, the visualization of a complete thrombosis of the splenic vein (white arrow head) and superior mesenteric (white arrow) of the pancreatic graft, hyperdense, is better observed on the sequence carried out without contrast agent injection (b) than on the sequence performed after injection (c).

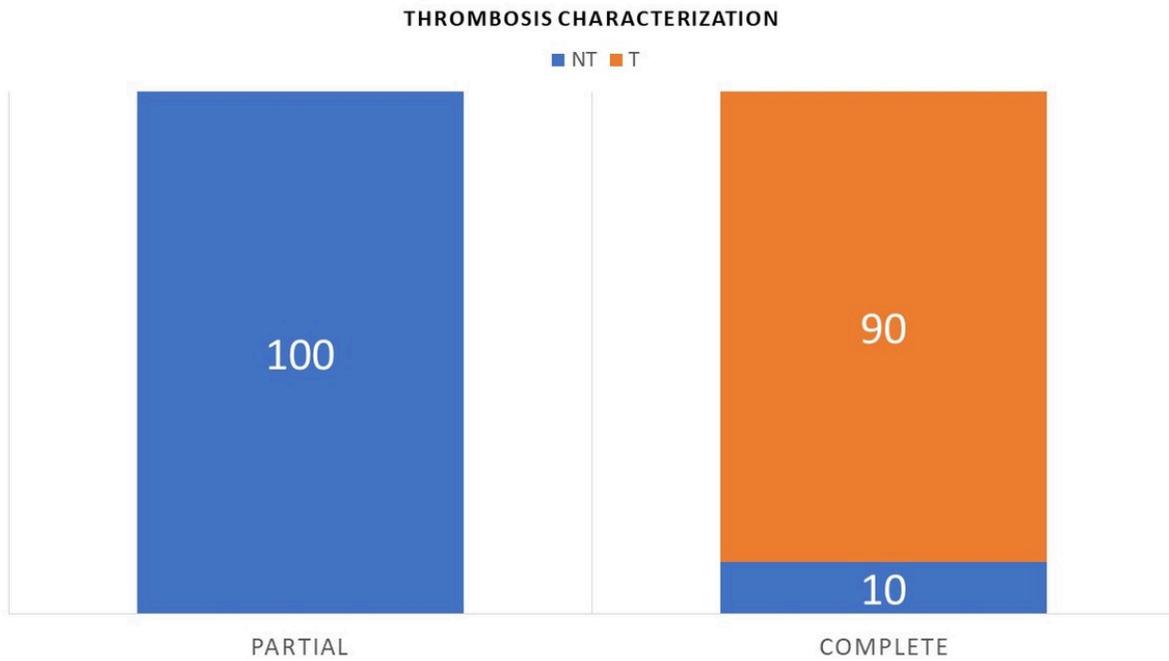


Fig. 7: T and NT group division based on complete or only partial vascular thromboses. Abbreviations: T = Transplantectomised group, NT = Non-transplantectomised group

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Conclusion

Our study has allowed to identify scanographic predictors of transplantectomy in a population of patients with thrombotic complications. These elements will provide the clinician with a support in his therapeutic orientation. We offer a radiological reading table and a diagram as simple prognostic tools to facilitate CT reading (**fig 8, fig 9**).

Images for this section:

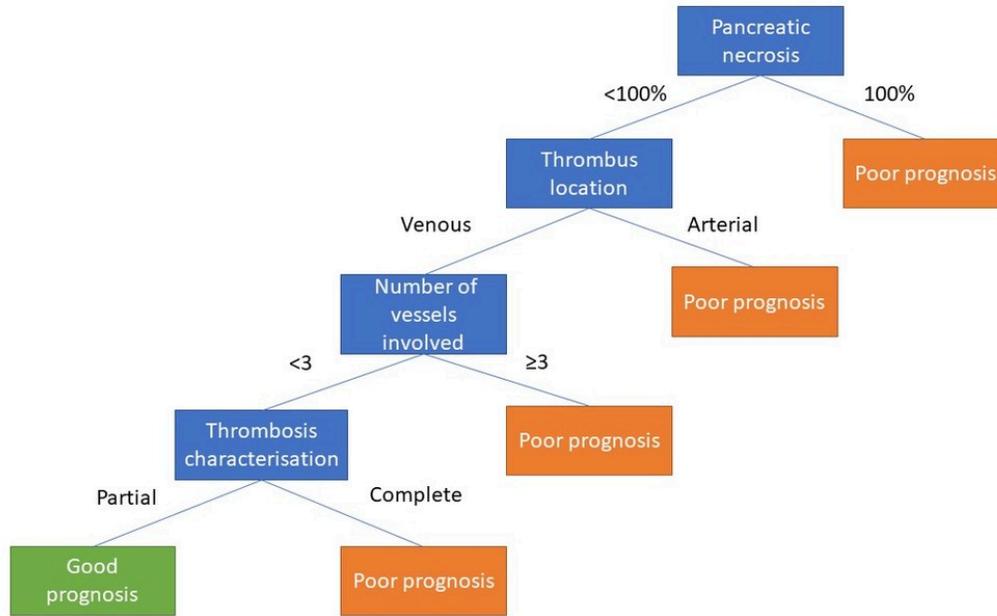


Fig. 8: Diagram representing pancreatic transplanted patients prognoses according to the various radiological predictive factors.

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READING TABLE

- ❖ Pancreatic necrosis:
 - 100%
 - < 100%

- ❖ Thrombus location:
 - Arterial
 - Venous

- ❖ Number of vessels affected:
 - ≥ 3
 - < 3

- ❖ Thrombosis characterisation:
 - Complete
 - Partial

Fig. 9: Radiological reading table for the evaluation of scanographic predictive factors of pancreatic transplantectomy.

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Personal information

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