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**Original article**

# **Atherosclerosis is associated with poorer outcome in non-occlusive mesenteric ischemia.**

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**Competing Interests:** None.

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Original research

**Atherosclerosis is associated with poorer outcome in non-occlusive mesenteric ischemia.**

**List of abbreviations**

**NOMI:** Non-Occlusive Mesenteric Ischemia

**OMI:** Occlusive Mesenteric Ischemia

**CT:** Computed Tomography

**MDCT:** Multi-Detector Computed Tomography

**ROI:** Region of Interest

**IV:** Intravenous

**NASCET:** North American Symptomatic Carotid Endarterectomy Trial

**PACS:** Picture Archiving and Communication System

**ASAT:** Aspartate Aminotransferases

**SMA:** Superior Mesenteric Artery

**KEYWORDS**

Atherosclerosis, Mesenteric Ischemia, Nonocclusive Mesenteric Ischemia, Multidetector Computed Tomography, Survival Analysis

## **Abstract**

**Purpose:** To evaluate whether abdominal atherosclerosis was associated with poorer outcome in a single-centre cohort of patients suffering from nonocclusive mesenteric ischemia (NOMI).

**Methods:** From January 2009 to December 2019, 121 consecutive patients from the critical care unit who underwent laparotomy for suspected NOMI and with available unenhanced and contrast-enhanced CT were included. Clinical and biological data at the time of the CT scan were retrospectively extracted from medical charts and reviewed by a single radiologist. Unenhanced CT acquisitions were used to calculate calcium scores of the abdominal aorta, celiac trunk, superior mesenteric artery (SMA) and common iliac arteries according to the Agatston method. Univariate and multivariate analysis were performed.

**Results:** Among the 121 patients with NOMI and calcium score calculation, only 4 patients had no aortic calcifications (3%) and 32 had no superior mesenteric artery calcification (26%). 35 patients (29%) died within 24 hours after the abdominal CT scan. Univariate analysis showed that a total abdominal calcium score greater than 15 000 (last quartile) was significantly associated with death within 24 hours (14 (40%) vs 17 (20%) patients,  $p = 0.035$ ). By multivariate analysis, a total abdominal calcium score greater than 15 000 was an independent risk factor for death (HR = 1.94, 95%CI [1.02 - 3.73],  $p = 0.044$ ). Regarding separate calcium scores, only a SMA calcium score greater than 50 was a risk factor for death (HR 2.46, 95%CI [1.14 - 3.93],  $p = 0.019$ ).

**Conclusion:** Our results show that abdominal atherosclerosis, especially in the SMA, is associated with poorer outcome in NOMI.

## Introduction

Non-occlusive mesenteric ischemia (NOMI) accounts for 20-30% of all acute mesenteric ischemia (1), and has a high mortality rate (50–83%) (2). NOMI is a form of acute mesenteric ischemia that is caused by splanchnic hypoperfusion without digestive vascular occlusion (1), reflecting intense splanchnic vasoconstriction (3,4), commonly caused by shock, hemorrhage, surgery, dialysis, hypovolemia, cardiogenic injuries, vasoactive treatments, or intoxication (5). The diagnosis of NOMI remains challenging, and previous studies have indicated that the diameter of the superior mesenteric artery could be of help in the diagnosis (6,7). However, the diagnosis of NOMI relies mainly on evidence of bowel injury, which may be difficult to interpret in case of reperfusion (4,6,8,9). Beyond the diagnosis of NOMI, the prognosis of patients suffering for NOMI prognosis is poor, and is not well understood, depending on various factors, such as disease severity, sepsis, shock and multiple organ failure. The link between NOMI and atherosclerosis is unclear, although it has been suggested that atherosclerosis is associated with NOMI pathogenesis (10,11). Furthermore, atherosclerosis has never been investigated as a potential risk factor for poor outcome in critically ill patients, since it was not possible to quantify the burden of atherosclerosis until relatively recently.

Atheroma of the abdominal aorta and its branches has a high prevalence (55 to 83 % in those over 40 years of age) (12–14) and has been identified as an independent predictor of vascular morbidity and mortality (15). Aorto-iliac calcifications (12) and abdominal visceral artery calcifications (16) are also associated with all-cause mortality, especially when calcifications reach the superior mesenteric artery (14). The quantification of atheroma is now possible thanks to the use of computed tomography (CT), and has been extensively studied in the coronary arteries (17,18). CT scan enables quantification of overall atherosclerotic calcification, and is expressed as the volume of calcifications in the vessel wall studied. The aortic calcium score has been investigated in only a few studies, notably in post-operative complications , but its wider investigation has probably been

hampered by feasibility problems. The quantification of atheroma thus makes it possible to assess the link between atheroma of the aortic and superior mesentery arteries, and survival in NOMI.

The aim of this study was to assess whether atherosclerosis, as measured by the calcium score of the aorta and mesenteric vessels, was associated with poorer outcome in a single-centre cohort of patients suffering from NOMI.

## **Materials and Methods**

This single-centre retrospective study was approved by our institutional review board. From January 1, 2009 to December 31, 2019, the medical charts of all consecutive patients from the critical care unit who had exploratory laparotomy for suspected NOMI were reviewed. The inclusion criteria were: 1) laparotomy for NOMI, 2) available unenhanced and contrast enhanced CT. NOMI was defined as evidence of bowel injury on preoperative abdominal CT, confirmed by surgical exploration. Patients with a history of occlusive mesenteric ischemia, a history of superior mesenteric artery occlusion, NOMI further to aortic surgery, and patients without available pathological reports were excluded. Patients with a prosthetic aortic valve were also excluded because the assessment of the calcium score is unreliable in these patients. Clinical and variables at the time of the CT were retrospectively extracted from the medical charts. The final study population included 121 patients (**Figure 1**).

### **CT protocol**

CT examinations were performed with 64 and 128 MD CT scanners (Brilliance 64, Philips Healthcare; Somatom Definition 128, Siemens Healthcare). In routine practice, the CT protocol for NOMI suspicion comprised an unenhanced acquisition and multiphase contrast-enhanced acquisitions. Early arterial phase images were acquired with bolus tracking (ROI located in the aorta), and portal venous acquisition was started 80 seconds after the start of intravenous (IV) contrast

administration. Contrast administration was an IV injection of 1.5 mL/kg of non-ionic contrast medium at 300–400 mg I/mL through a power injector at a rate of 3–4 mL/s.

### **Imaging analysis**

All abdominal CT scans were blindly reviewed by a single radiologist with 5 years experience in the field of abdominal imaging. Unenhanced acquisitions CT were imported to an AW workstation (GE HEALTHCARE, Chicago, Illinois) to calculate the calcium scores of the abdominal aorta, celiac trunk, superior mesenteric artery and common iliac arteries using Smartscore 4.0 software (GE HEALTHCARE) according to the Agatston method (18) (**Figure 2**). The abdominal aorta was defined as the segment from the diaphragm to the iliac bifurcation. Ostial calcifications of the celiac trunk and the superior mesenteric artery were included in both scores, i.e. in the score of the abdominal aorta and in that of the respective artery (celiac trunk or superior mesenteric artery).

Stenosis of the celiac trunk and superior mesenteric artery were evaluated by the NASCET method (23) using multiplanar reconstructions on a PACS workstation (CARESTREAM HEALTH, Rochester, NY). Concerning the lower mesenteric artery, its small size precluded reliable calculation of a calcium score or a percentage stenosis, and thus, the diameter of its origin and the presence of stenosis or occlusion were recorded. The maximum antero-posterior diameter of the abdominal aorta was also measured.

### **Statistical Analysis**

Categorical data are expressed as number and percentage and were compared by Pearson chi squared or Fisher's exact test. Continuous variables are expressed as mean, and standard deviation or median, interquartile range, and were compared using Student's t test when the distribution was normal, or the Wilcoxon test when the distribution was not normal. Continuous

biological variables associated with 24h death were dichotomized with the help of the intensive care unit score, or with the lower limit of normal value.

All calcium scores and percent stenosis are described as continuous variables, were categorized according to the median and third quartile. A total abdominal calcium score was calculated as the sum of the scores from the aorta, celiac trunk, mesenteric, right and left common iliac arteries. The total abdominal calcium score was also expressed as a continuous variable and categorized according to the median and third quartile.

To assess the effect of atherosclerosis on prognosis, three Cox proportional hazards logistic regression models were built. The models included all binary clinical and biological variables associated with 24 hours death with a p value < 0.05 by univariate analysis. We considered only one biological variable for liver failure (from among ASAT, bilirubin and PT) due to collinearity. In the first model, the total abdominal calcium score was included as a continuous variable. In the second model, the total abdominal calcium score was included as a binary variable, dichotomized according to a threshold of > 15000 (third quartile). The third and final model included all binary variables associated with death within 24h with a p value < 0.20 by univariate analysis.

All tests were two sided and a p value < 0.05 was considered statistically significant. All analyses were performed with R version 3.4.4 (R Core Team 2017).

## Results

### Study Population

The characteristics of the study population are presented in **Table 1**. The mean age was 68.7 ± 10.3 years, and there were 75 men (75/121; 62%) and 46 women (46/121; 38%). The etiology of NOMI was surgical in 68 patients (68/121; 56%): cardiac surgery (n = 36, 36/121; 30%) and abdominal surgery (n = 25, 25/121; 21%) were the two main surgical causes. NOMI was secondary to medical disease in 53 patients (53/121; 44%), predominantly sepsis (n = 22, 22/121; 18%). At the time of the CT, 86 patients (86/121; 71%) were receiving mechanical ventilation, 76 patients (76/121; 65 %) had catecholamine infusion, and 23 patients (23/121; 22 %) had continuous venovenous hemodiafiltration. Among the study population, 35 patients (35/121; 29%) died within 24 hours of abdominal CT scan.

### Clinical and biological variables associated with death within 24 hours

The results of the univariate analysis according to the occurrence of death within 24 hours of abdominal CT scan are summarized in **Table 1**. Catecholamine infusion was associated with death within 24 hours (48 patients alive (51%) vs 28 patients dead (84%), p = 0.020). Hemoglobin was significantly lower in patients who died within 24 hours (median 9.2 vs 10.1 g/dL, p = 0.031). Lactate levels were significantly higher in patients who died within 24 hours (median 7.4 vs 3.1 mmol/L, p < 0.001), as were ASAT levels (445 vs 60 UI/L, p < 0.001). The prothrombin rate was significantly lower in patients who died within 24 hours (43 vs 61%, p < 0.001), as was blood pH (7.22 vs 7.39, p < 0.001), and bicarbonates level (17 vs 22 mmol/L, p < 0.001).

### Atherosclerosis CT features

The median percentage of celiac trunk and superior mesenteric artery stenosis was 37% (IQR = 13 – 57) and 15% (IQR = 0 – 39), respectively (**Table 2** and **Figure 3**). The median calcium score of the celiac trunk, superior mesenteric artery, abdominal aorta, common right iliac artery, and

common left iliac artery was 141 (IQR = 12 – 363), 54 (IQR = 0 – 377), 4669 (IQR = 1444 – 10179), 1008 (IQR = 278 – 2724), and 937 (IQR = 281 – 2556), respectively. The median of the total abdominal calcium score was 6984 (IQR = 2347 – 15156). Among the study population, only 4 patients had no aortic calcifications (3%) and 32 had no superior mesenteric artery calcification (26%).

Univariate analysis (**Table 2**) found that the maximal diameter of celiac trunk was significantly lower in patients who died within 24 hours of abdominal CT scan (mean = 4.7 mm ± 1.4 vs 6.0 ± 1.8,  $p < 0.001$ ), as was the maximal diameter of superior mesenteric artery (5.2 ± 1.5 vs 5.9 ± 1.5 mm,  $p = 0.017$ ). A total abdominal calcium score greater than 15 000 (last quartile) was significantly associated with death within 24 hours (14 (40%) vs 17 (20%) patients,  $p = 0.035$ ). There were no significant differences between groups for the other calcium scores.

There was a significant correlation between aortic and SMA Agatston scores ( $r=0.61$ , 95%CI (0.49 – 0.71)) (**Figure 4**).

### **Multivariate analysis**

Total abdominal calcium score was significantly associated with death within 24h, both when considered as a continuous variable and when considered as a binary variable according to the last quartile (HR = 1.0, 95%CI [1.00 - 1.00],  $p = 0.034$  and HR = 1.94, 95%CI [1.02 - 3.73],  $p = 0.044$  as continuous and binary variable respectively, **Tables 3 and 4**).

The third multivariate Cox regression model including separate calcium scores is summarized in **Table 5**. In this last model, amongst all calcium scores included in the multivariate model, only superior mesenteric artery calcium score greater than 50 was a risk factor for death (HR = 2.46, 95%CI [1.14 - 3.93],  $p = 0.019$ )

## Discussion

This is the first study to analyze atherosclerosis in NOMI. Our study suggests that atherosclerosis, especially when localized in the superior mesenteric artery, is an independent risk factor for death in patients with NOMI. This result is relevant, since the quantification of atherosclerosis using the calcium score, to investigate atherosclerosis as potential independent risk factor for death had never previously been performed in critically ill patients, especially those with NOMI. A few studies have already shown that risk factors for atherosclerosis were associated with poorer prognosis in critical care patients, but the link between prognosis and atherosclerosis in critical care patients had never been directly studied. We demonstrate here that the link between prognosis and atherosclerosis exists in NOMI patients, and this raises the question of the prognostic value of atheroma in the broadest sense in critical care patients. Atherosclerosis may play a role in the maladaptation of microvascularization to a low flow state, and in the response to vasopressor amines, thereby promoting ischemia of the abdominal viscera, and contributing to multiorgan failure.

We found that the prevalence of aortic atheroma was very high: 97% of patients had aortic calcifications. However, these results appear to be similar to those observed in the general population, when compared with the few studies available on the subject. Beser et al. (13) reported that 99 % of 88 patients over 60 years had atherosclerotic plaques in the abdominal aorta and its branches. Allison et al. (12) reported that 55% of 4454 patients had abdominal aortic calcifications, but their average age was 56 years versus 68 years in our study, and the prevalence of atheroma increases with age (24), which could explain this difference in prevalence. However, our results are different from those observed in the study by Beser et al. (13) concerning superior mesenteric artery calcifications: 74% of patients in our study cohort had superior mesenteric artery calcifications, compared to only 9 of 261 patients (3.4%) in the study by Beser et al. In their study, they included patients undergoing abdominal CT for any reason. Although the average age of patients is higher in

our study, (68 years versus 53 years), this difference in prevalence nonetheless seems significant. These results suggest that atherosclerosis of the superior mesenteric artery plays a role in the development of NOMI.

The clinical significance of aortic calcium scores and abdominal arteries has not been widely studied in the literature. A few authors studied atheroma as a risk factor for anastomosis leakage (22) (25) or as being associated with the diameter of the main bile duct (26). Our study suggests that among the abdominal arteries, calcifications of the superior mesenteric artery were the most strongly associated with mortality. This is interesting, and has never previously been reported. Mesenteric atheroma has already been studied in ischemic colitis as a marker of poor long-term prognosis (27), but the atheroma was only evaluated during surgery and no quantitative evaluation was performed. A noteworthy finding of our study is that atheroma does not have the same prognostic value according to its localization, and that the correlation between atheroma of the aorta and of the SMA was only 0.61. Similar to coronary artery atheroma, which is an independent prognostic marker by virtue of its localization, atheroma in the superior mesenteric artery could also be considered as an independent marker of poorer outcome. This findings warrants confirmation in further, larger studies, and represents a potential avenue for future research in this area.

Our study has some limitations. It was a single-center, retrospective study, thus leaving potential for unavoidable bias. Second, there is potential for selection bias due to the calculation of calcium score method, which requires unenhanced abdominal CT, without aortic surgery or endoprosthesis. Our study did not include a control group, and therefore did not enable us to determine whether mesenteric atheroma was a risk factor for bowel necrosis. It only allows us to conclude that atheroma is a marker of poor prognosis in the context of NOMI, without elucidating the link between the two. A final limitation of our study is the analysis by a single radiologist. However, to avoid measurement bias, we used validated and reproducible methods for the calculation of calcium scores and stenosis percentages.

## **Conclusion**

Our results show that abdominal atherosclerosis is associated with poorer outcome in the context of NOMI. Among the different calcium scores studied, the calcium score of the superior mesenteric artery was the most strongly associated with survival. As with coronary atheroma, localized atheroma of the superior mesenteric artery could constitute an independent prognostic marker beyond the context of NOMI. This requires confirmation in further studies.

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## TABLES

**Table 1. Characteristics of the study population. Univariate analysis according to death within 24 hours of abdominal CT scan.**

Total	n=121	Death within the 24h		P Value
		No = 86	Yes = 35	
<b>Etiologies</b>				
<b>Surgery, n (%)</b>	68 (56)	50 (58)	18 (51)	
Cardiac surgery, n (%)	36 (30)	25 (29)	11 (31)	
Abdominal surgery, n (%)	25 (21)	21 (24)	4 (11)	
Urologic surgery, n (%)	4 (3)	3 (35)	1 (3)	
Vascular surgery, n (%)	2 (2)	1 (1)	1 (3)	
Orthopedic surgery, n (%)	1 (1)	0 (0)	1 (3)	
				0.375
<b>Medical, n (%)</b>	53 (44)	37 (43)	16 (46)	
Sepsis, n (%)	22 (18)	16 (19)	6 (17)	
Cardiorespiratory arrest, n (%)	12 (10)	8 (9)	4 (11)	
Hemorrhage, n (%)	7 (6)	5 (6)	2 (6)	
Respiratory insufficiency, n (%)	10 (8)	6 (7)	4 (11)	
Cardiac failure, n (%)	2 (2)	2 (2)	0 (0)	
<b>Age, mean ± sd</b>	68.7 ± 10.3	67.5 ± 10.1	71.7 ± 10.4	0.050
<b>Sex (male) , n (%)</b>	75 (62)	53 (62)	22 (63)	1
<b>Variables at the time of the CT</b>				
Mechanical ventilation, n (%)	86 (71)	63 (73)	23 (66)	<b>0.568</b>
Catecholamine infusion, n (%)	76 (63)	48 (56)	28 (80)	<b>0.020</b>
Hemoglobin (g/dl), median (IQR)	9.8 (8.8 - 11.5)	10.1 (8.8 - 11.8)	9.2 (8.6 - 10.5)	<b>0.031</b>
Platelets, median (IQR)	169 (117 - 277)	186 (122 - 195)	150 (114 - 187)	0.069
Lactate, mmol/L, median (IQR)	4.1 (2 - 7)	3.1 (1.5 - 4.9)	7.4 (5.7 - 11.2)	<b>&lt; 0.001</b>
Creatinine,mmol/L, median (IQR)	150 (101 - 204)	139 (95 - 187)	184 (131 - 241)	0.021
Bilirubin,mmol/L, median (IQR)	18 (12 - 41)	15 (12 - 34)	24 (15 - 49)	<b>0.092</b>
ASAT, UI/L, median (IQR)	83 (35 - 501)	60 (32 - 191)	445 (94 - 2300)	<b>&lt; 0.001</b>
Prothrombin rate, %, median (IQR)	55 (35 - 71)	61 (43 - 74)	43 (27 - 54)	<b>&lt; 0.001</b>
pH, median (IQR)	7.33 (7.20 - 7.43)	7.39 (7.27 - 7.45)	7.22 (7.08 - 7.32)	<b>&lt; 0.001</b>
Bicarbonates (mmol/l) , median (IQR)	18 (14 - 22)	22 (18 - 24)	17 (13 - 19)	<b>&lt; 0.001</b>

**Abbreviations: ASAT: Aspartate Aminotransferases**

**Table 2. Atherosclerosis CT features. Univariate analysis according to death within 24 hours of abdominal CT scan.**

Total	n=121	Death within 24h		P value
		No = 86	Yes = 35	
<b>Celiac trunk</b>				
Maximal diameter (mm), mean ± sd	5.6 ± 1.8	6.0 ± 1.8	4.7 ± 1.4	< 0.001
Minimal Diameter (mm), mean ± sd	3.6 ± 2.01	4.0 ± 2.1	2.7 ± 1.4	< 0.001
Stenosis (%), n (%)	37 (13 - 57)	31 (13 - 57)	45 (27 - 59)	0.14
Stenosis >25%, n (%)				
Stenosis >50%, n (%)				
Calcium score, median (IQR)	141 (12 - 363)	124 (15 - 325)	253 (2 - 495)	0.493
Calcium score > 140, n (%)	61 (50)	41 (48)	20 (57)	0.456
Calcium score > 360, n (%)	31 (25)	19 (22)	12 (34)	0.247
<b>Superior mesenteric artery</b>				
Maximal diameter (mm), mean ± sd	5.7 ± 1.5	5.9 ± 1.5	5.2 ± 1.5	<b>0.017</b>
Minimal Diameter (mm), mean ± sd	4.5 ± 2.1	4.7 ± 2.0	4.0 ± 2.1	0.090
Stenosis (%), median (IQR)	15 (0 - 39)	12 (0 - 20)	18 (0 - 40)	0.598
Stenosis >25%, n (%)	49 (40)	33 (38)	16 (46)	0.541
Stenosis >50%, median (IQR)	19 (16)	12 (14)	7 (20)	0.418
Calcium score, median (IQR)	54 (0 - 377)	32 (0 - 303)	100 (5 - 756)	0.086
Calcium score > 50, n (%)	61 (50)	39 (45)	22 (63)	0.122
Calcium score > 370, n (%)	31 (25)	19 (22)	12 (34)	0.140
<b>Abdominal Aorta</b>				
Calcium score, median (IQR)	4669 (1444 - 10179)	4210 (1529 - 9030)	6238 (1422 - 15574)	0.245
Aortic calcium score > 4600, n (%)	61 (50)	41 (48)	20 (57)	0.457
Aortic calcium score > 10000, n (%)	30 (25)	17 (20)	13 (9)	0.076
<b>Iliac artery*</b>				
Common right calcium score, median (IQR)	1008 (278 - 2724)	900 (415 - 1925)	2023 (257 - 3804)	0.318
Common right calcium score > 1000, n (%)	60 (50)	40 (47)	20 (57°)	0.422
Common right calcium score > 2700, n (%)	31 (25)	18 (21)	13 (37)	0.113
Common left calcium score, median (IQR)	937 (281 - 2556)	762 (271 - 2237)	1489 (342 - 3720)	0.177
Common left calcium score > 1000, n (%)	59 (50)	38 (44)	21 (60)	0.154
Common left calcium score > 2600, n (%)	29 (25)	16 (19)	13 (37)	0.050
<b>Total abdominal calcium score</b>				
Total calcium score, median (IQR)	6984 (2347 - 15156)	6482 (2527 - 12584)	13106 (1872 - 23214)	0.229
Total calcium score > 7000, n (%)	59 (50)	40 (47)	19 (54)	0.542
Total calcium score > 15000, n (%)	31 (25)	17 (20)	14 (40)	<b>0.035</b>

\* variables are expressed in % of available data (n=118).

IQR = interquartile range;

**Table 3. First multivariate Cox regression model. Model 1 including all variables associated with death within 24 hours by univariate analysis plus Total abdominal calcium score.**

		Multivariate Cox regression model 1		
		HR	95% CI	p value
<b>Clinical data</b>				
	Age	0.99	0.97 - 1.03	0.967
	Catecholamine infusion	2.13	1.07 - 4.22	<b>0.030</b>
<b>Blood tests</b>				
	Hemoglobin < 10 g/dl	0.93	0.52 - 1.66	0.814
	Lactates > 4 mmol/l	2.38	1.31 - 4.34	<b>0.005</b>
	Creatinine > 200 mmol/L	1.32	0.73 - 2.37	0.355
	ASAT > 100 UI/L	1.90	1.05 - 3.43	<b>0.034</b>
	pH < 7.35	1.59	0.90 - 2.82	0.107
	Bicarbonates < 15 mmol/l	1.63	0.84 - 3.17	0.144
<b>CT variables</b>				
	Celiac trunk maximal diameter	0.93	0.78 - 1.11	0.441
<b>Calcium score variable</b>				
	Total abdominal calcium score	1	1.00 - 1.00	<b>0.034</b>

HR, hazard ratio; CI, confidence interval.

**Table 4. Second multivariate Cox regression model. Model 2 including all variables associated with death within 24 hours by univariate analysis plus Total abdominal calcium score as a dichotomized variable (last quartile).**

		Multivariate Cox regression model 2		
		HR	95% CI	p value
<b>Clinical data</b>				
	Age	1.77	0.97 - 1.03	0.967
	Catecholamine infusion	2.12	1.16 - 4.53	<b>0.030</b>
<b>Blood tests</b>				
	Hemoglobin < 10 g/dl	0.96	0.53 - 1.73	0.814
	Lactates > 4 mmol/l	2.23	1.23 - 4.04	<b>0.004</b>
	Creatinine > 200 mmol/L	1.29	0.72 - 2.34	0.391
	ASAT > 100 UI/L	1.80	0.99 - 3.28	0.051
	pH < 7.35	1.59	0.90 - 2.83	0.107
	Bicarbonates < 15 mmol/l	1.66	0.85 - 3.23	0.135
<b>CT variables</b>				
	Celiac trunk maximal diameter	0.93	0.78 - 1.10	0.393
<b>Calcium score variable</b>				
	<b>Total Agatston calcium score &gt; 15000</b>	<b>1.94</b>	<b>1.02 - 3.73</b>	<b>0.044</b>

HR, hazard ratio; CI, confidence interval.

**Table 5. Third multivariate Cox regression model. Model 3 including all variables associated with death within 24 hours by univariate analysis plus the calcium score from each vessel associated with death with a p value < 0.20.**

		<b>Multivariate Cox regression model 3</b>		
		<b>HR</b>	<b>95% CI</b>	<b>p value</b>
<b>Clinical data</b>				
	Age	1.00	0.9 - 1.03	0.938
	Catecholamine infusion	2.35	1.18 - 4.71	<b>0.015</b>
<b>Blood tests</b>				
	Hemoglobin < 10 g/dl	0.90	0.49 - 1.66	0.753
	Lactates > 4 mmol/l	2.33	1.23 - 4.39	<b>0.009</b>
	Creatinine > 200 mmol/L	1.56	0.83 - 2.93	0.161
	ASAT > 100 UI/L	1.99	1.06 - 3.72	<b>0.031</b>
	pH < 7.35	2.01	1.09 - 3.69	<b>0.025</b>
	Bicarbonates < 15 mmol/l	1.69	0.86 - 3.32	0.127
<b>CT variables</b>				
	Celiac trunk maximal diameter	0.98	0.82 - 1.18	0.851
<b>Calcium score variable</b>				
	SMA calcium score > 50	2.46	1.14 - 3.93	<b>0.019</b>
	SMA calcium score > 370	1.96	0.51 - 2.15	0.236
	Aortic calcium score > 10000	0.51	0.46 - 2.06	0.257
	Right commun iliac artery calcium score > 2700	0.70	0.36 - 2.84	0.529
	Left commun iliac artery calcium score > 2600	1.21	0.23 - 2.24	0.236

HR, hazard ratio; CI, confidence interval.

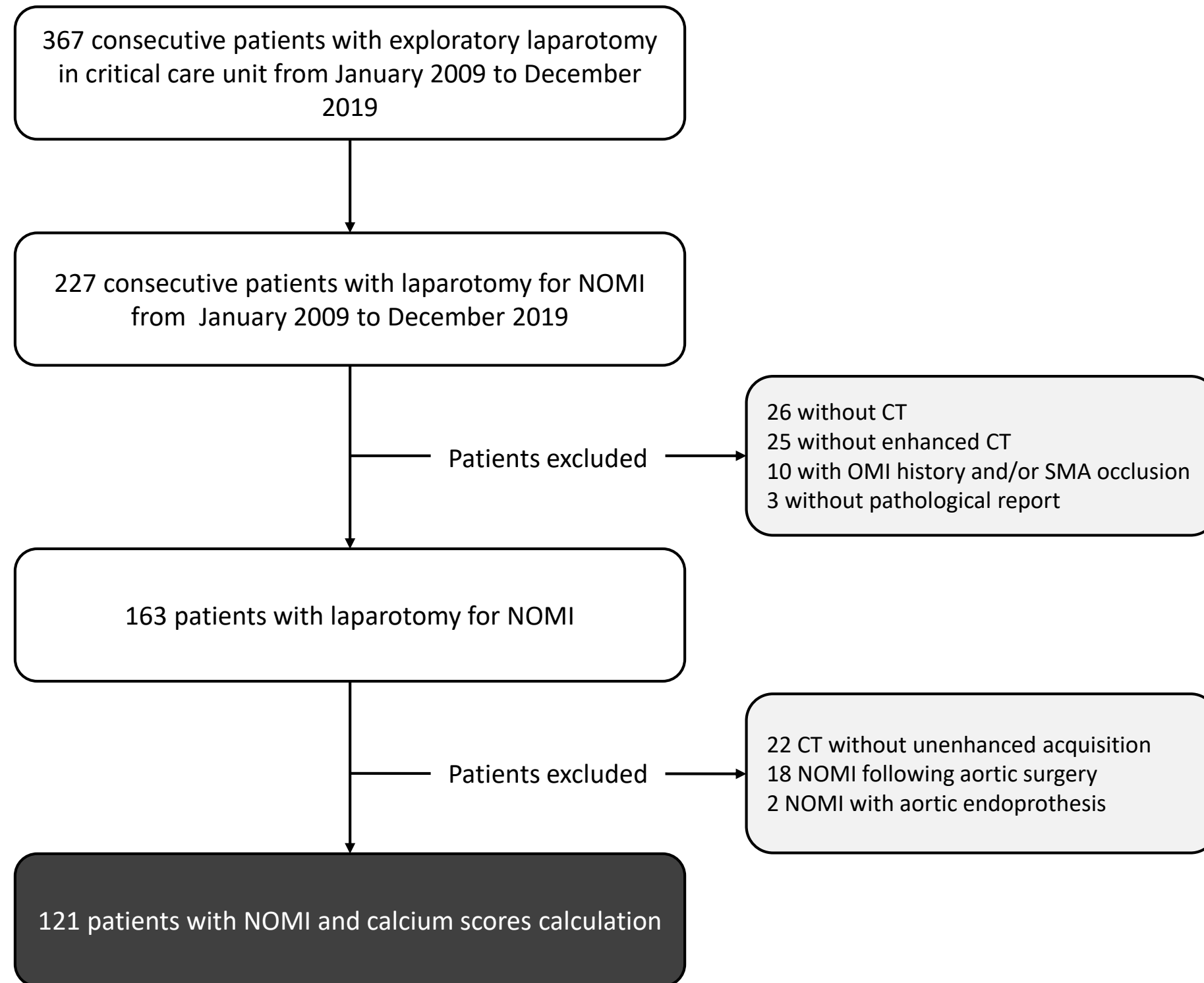
## Figure Legends

**Figure 1.** Flow chart of the study population.

**Figure 2.** 81 year old man with nonocclusive mesenteric ischemia confirmed on surgical exploration. Calculation of abdominal calcium scores: aorta (red) = 9355, celiac trunk (dark blue) = 716, superior mesenteric artery (orange) = 1321, right iliac artery (brown) = 980, left iliac artery (light blue) = 1301. **A.** Unenhanced CT shows calcifications of the superior mesenteric artery (orange) and aorta (red). **B.** Maximal intensity projection shows all vascular abdominal calcifications measured.

**Figure 3.** Boxplots of distribution of superior mesenteric artery stenosis percentages and calcium scores according to death within 24h of abdominal CT scan. SMA=Superior mesenteric artery; RCIA=Right common iliac artery; LCIA=Left common iliac artery.

**Figure 4.** Correlation between aortic and superior mesenteric artery calcium scores.



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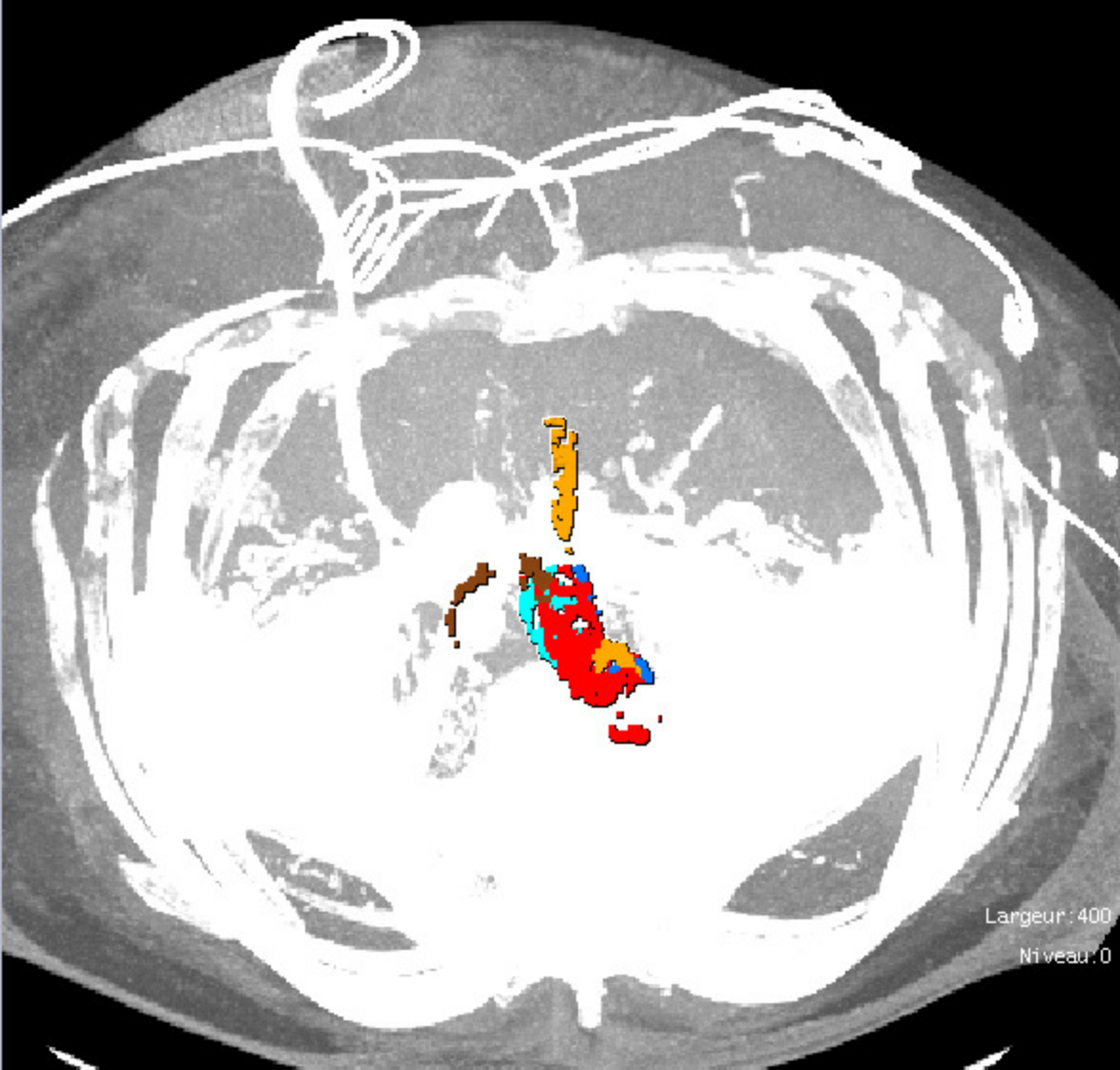
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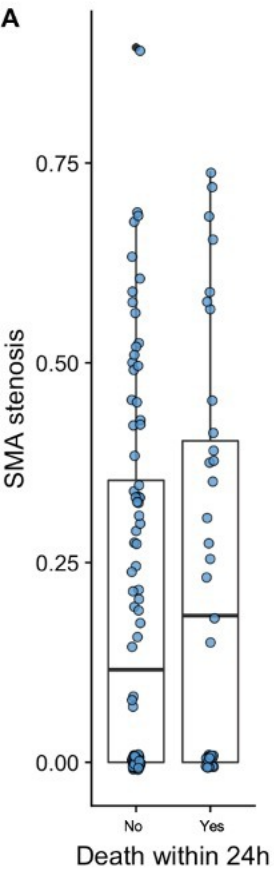
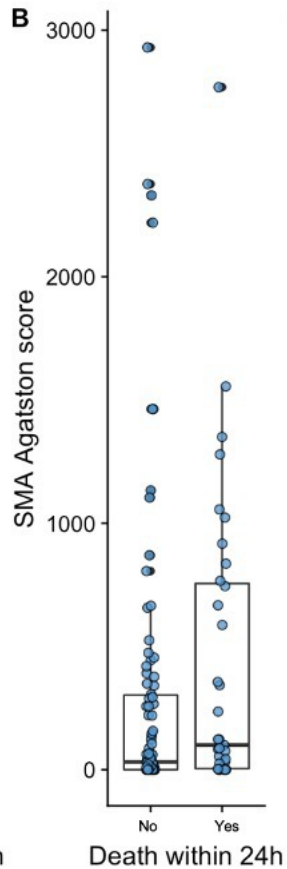
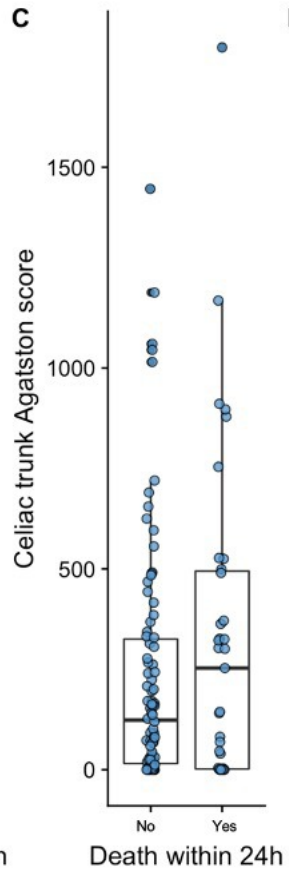
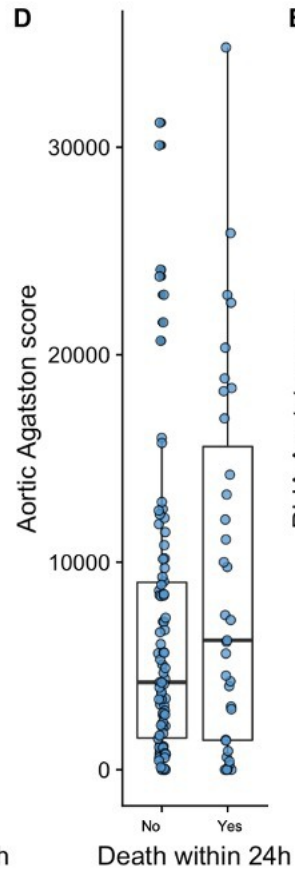
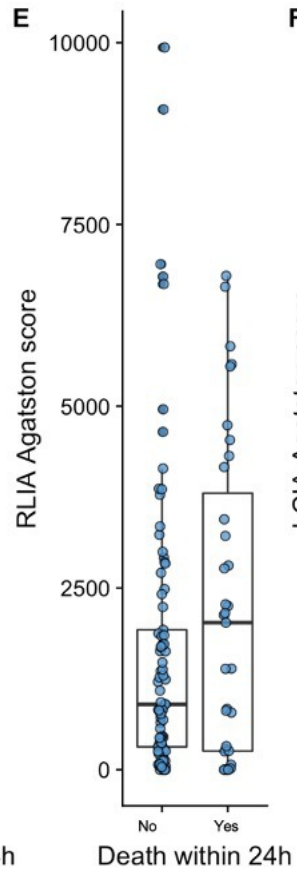
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