Preoperative computed tomography angiography (CTA) of the body in vascular patients: prevalence and significance of unsuspected extravascular findings

Präoperative computertomografische Angiografie (CTA) des Rumpfes von Patienten der Gefäßchirurgie: Prävalenz und Signifikanz unerwarteter extravaskulärer Befunde

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ZUSAMMENFASSUNG

Ziel Evaluation der Prävalenz und Signifikanz von unerwarteten extravaskulären Befunden in Ganzkörper-computertomografischen Angiografie-Scans (CTA) vor endovaskulärer oder chirurgischer Behandlung von Gefäßpatienten.

Material und Methoden Diese Studie wurde von der örtlichen Ethikkommission genehmigt. Es wurden radiologische Befunde von Patienten, die eine Ganzkörper-CTA im Zeitraum zwischen Januar 2004 und Dezember 2014 vor endovaskulärer oder chirurgischer Therapie von Erkrankungen der Gefäße erhielten, retrospektiv aufgearbeitet. Alle unerwarteten extravaskulären Befunde wurden als klinisch nicht relevant (Verlaufskontrollen nicht indiziert) oder klinisch relevant (Verlaufskontrollen/sofortige Behandlung indiziert) klassifiziert. Der weitere Verlsauf von Patienten mit klinisch relevanten extravaskulären Befunden wurde retrospektiv evaluiert.

Ergebnisse Es wurden 806 Patienten in diese Studie eingeschlossen (592 Männer; Durchschnittsalter 67 Jahre). Bei 778 (96,5 %) von 806 Patienten wurden insgesamt 3293 extravaskuläre Zufallsbefunde festgestellt. Darunter befanden sich 259 suspekte Befunde bei 205 Patienten (25,4 %), die Verlaufskontrollen oder eine sofortige Behandlung erforderten. Ein bis dahin unbekanntes Malignom wurde bei 23 Patienten (2,9 %) diagnostiziert, darunter waren 10 Patienten (1,2 %) mit einem Lungenkarzinom. Bei Männern wurden mehr maligne Tumoren nachgewiesen als bei Frauen (3,5 % versus 0,9 %; p = 0,055; Fisher-Test). Patienten mit einem zufällig entdeckten malignen Tumor waren signifikant älter als Patienten ohne Tumorbefund (Durchschnittsalter 72,3 vs. 67,5 Jahre; p = 0,0432; t-test).

Fazit Klinisch relevante extravaskuläre Zufallsbefunde treten häufig auf bei Gefäßpatienten. Besonders beachtenswert sind maligne Tumoren der Lunge.

Kernaussagen

- Bei 25,4 % der Patienten wurden klinisch relevante extravaskuläre Zufallsbefunde diagnostiziert.
- Die Inzidenz maligner Tumoren lag bei 2,9 %.
- Das Bronchialkarzinom hat unter den Malignomen die höchste Inzidenz (1,2 %).

ABSTRACT

Purpose Evaluation of the prevalence and significance of unsuspected extravascular findings on computed tomography angiography (CTA) of the body before endovascular or surgical treatment in vascular patients.

Materials and Methods This study was approved by the local institutional review board. Radiology reports of 806 patients who underwent CTA of the body during January 2004 until December 2014 before endovascular or surgical treatment of vascular diseases were retrospectively reviewed. All unexpected extravascular abnormalities were classified as clinically non-significant (requiring no follow-up) or clinically significant (requiring further follow-up/immediate treatment). The course of patients with significant extravascular findings was retrospectively evaluated.

Results Overall 806 patients were included in this study (592 men; mean age: 67 years). In 778 (96.5 %) of 806 patients 3293 incidental extravascular findings were diagnosed. There were 259 suspicious findings in 205 patients (25.4 %) that required further follow-up or immediate treatment. A previously unknown malignant tumor was diagnosed in 23 (2.9 %) patients. 10 patients (1.2 %) were diagnosed with lung cancer. Malignant tumors were detected more often in men than in women (3.5 % versus 0.9 %). Patients with an incidental tumor were significantly older than patients without a tumor (mean age: 72.3 vs. 67.5 years).

Conclusion Clinically significant unexpected extravascular findings are common in vascular patients. Especially noteworthy are malignant tumors of the lung.

Key points

- Clinically relevant extravascular findings were detected in 25.4 % of the patients.
- The incidence of malignant tumors was 2.9 %.
- Lung cancer had the highest incidence among all malignancies (1.2 %).

Citation Format

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Introduction

Multislice spiral computed tomography angiography (CTA) of the body is a widely used and recommended imaging modality before endovascular and surgical treatment of aortic aneurysms and occlusive disease of the great arteries. For the planning of both endovascular and surgical treatment, the scan includes the body of the patient from neck to groin as a standard feature. As a result, the entire arterial system within this area gets depicted. This approach is required to plan the intervention of the current vascular disease [1, 2]. However, besides vascular structures, all of the surrounding organs of the thorax, abdomen and pelvis are completely depicted by CTA without an additional dose and this data has to be carefully evaluated. The objective of this study was to evaluate the incidence and clinical significance of unexpected extravascular findings in patients undergoing whole-body CTA before endovascular or surgical treatment in a large patient population.

Materials and methods

Patients

This retrospective single-center study was approved by the local institutional review board. We reviewed all vascular patients who underwent CTA at our university hospital between January 2004 and December 2014, whose CT scans fulfilled the following criteria:

1. Only the first available preoperative CTA was included.
2. Externally performed CT scans were not considered.
3. The CTA dataset included the entire thorax, abdomen, and pelvis.

The indications for CTA are specified in ▶ **Table 1**.

Image acquisition

During the study period two different multiple detector computed tomography (MDCT) scanners were used at our university hospital (Somatom Sensation 16 and Somatom Flash Dual Source; Siemens, Erlangen, Germany). Scans were usually performed after power injection of 90 – 160 ml of non-ionic contrast agent (e. g. Ultravist 370, Bayer-Schering AG, Berlin, Germany) at a rate of 3 – 4 mL/s. For image analysis transverse and coronal planes with a slice thickness of 3.0 mm were reconstructed (kernel: B26f), supplemented with parasagittal planes to detect pathologies of the aortic arch. A lung window with a slice thickness of 5.0 mm (kernel: B60f) in transverse and coronal planes was calculated for all patients. All CTA datasets were stored digitally in our Picture Archiving and Communication System (PACS).

Image analysis

A retrospective analysis of the digitally stored final radiology reports was done by the study coordinators (author #1 and author #8) in consensus. All images were originally evaluated by both a resident and a senior radiologist. Any documented unexpected extravascular abnormality was classified into one of two groups by the study coordinators based on their expected clinical relevance. The first group comprised patients with clinically non-significant extravascular findings, who did not require additional follow-up or treatment. The second group encompassed patients with unsuspected clinically significant extravascular findings requiring further examination or immediate treatment.

▶ **Table 1** Main indication for CTA in 806 vascular patients.

▶ **Tab. 1** Indikation für eine CTA bei 806 Patienten der Gefäßchirurgie.

main indication for preoperative CTA	n	(%)	mean age (range)	gender male
aortic aneurysm	474	(58.8)	71 (36 – 91)	375 (79.1 %)
aortic dissection	97	(12.0)	57 (20 – 84)	61 (62.9 %)
penetrating atherosclerotic ulcers	15	(1.9)	72 (56 – 82)	12 (80.0 %)
arterial stenosis	141	(17.5)	68 (21 – 91)	100 (70.9 %)
▪ aorta	18	(2.2)		
▪ supraaortic arteries	42	(5.2)		
▪ visceral arteries	13	(1.6)		
▪ Iliac arteries	68	(8.4)		
detection of embolic sources	50	(6.2)	69 (38 – 90)	26 (52.0 %)
miscellaneous	29	(3.6)	70 (46 – 91)	18 (62.1 %)

Clinical outcomes

The course of the patients in the second group was retrospectively evaluated by using our medical database and by analyzing all available follow-up images. Non-calcified solid pulmonary nodules were retrospectively processed according to the guidelines from the Fleischner Society [3]. Lymph nodes > 10 mm (short axis) were considered to be a significant finding. Cystic formations of the kidneys were categorized according to the Bosniak classification system [4]. Significant extravascular findings that were already documented in the patient's medical history were not taken into account.

Statistical analysis

Fisher's exact test and t-test were used. A p-value (two-sided) of 0.05 is considered statistically significant. Data entry and calculations were made with the software package SPSS (Chicago, EUA).

Results

Between January 2004 and December 2014, 806 patients (mean age: 67 years; range: 20 – 91 years) fulfilled the inclusion criteria. 592 (73.4 %) of those were male (mean age: 67 years; range: 20 – 91 years), and 214 (26.6 %) were female (mean age: 70 years; range: 25 – 91 years). A total of 3293 incidental extravascular findings were diagnosed in 778 patients (778/806; 96.5 %). The results of clinically non-significant and significant findings are summarized in Tables 2 and 3.

Non-significant findings

Most unsuspected extravascular findings had no further consequences for the patients (3034/3293; 92.1 %). Overall, non-significant extravascular findings were diagnosed in 768 patients (768/806; 95.3 %). Degenerative spine disease/arthrosis (433/806; 53.7 %), benign simple renal cysts (270/806; 33.5 %), goiter (227/806; 28.2 %) and asymptomatic colonic diverticula (202/806; 25.1 %) were the most frequent non-significant findings (▶ **Table 2**).

Significant findings

259 of 3293 findings (7.8 %) in 205 patients (205/806; 25.4 %) required further clinical follow-up, imaging or immediate treatment (▶ **Table 3**). In 60.5 % of the patients (124/205), the significant finding was located in the thorax. Most clinically significant extravascular findings were lesions or signs potentially suspicious of malignancy (196/259; 75.7 %). Those were found in 164 patients (164/806; 20.3 %).

Non-malignant findings

The incidences of significant non-malignant findings are summarized in ▶ **Table 3**. The most frequently detected, clinically relevant non-malignant findings were abnormalities suspicious of pulmonary infection (29/806; 3.6 %). After additional workup, systemic antibiotic therapy was started in 11 (11/29; 37.9 %) of these patients. Interlobular septal thickening due to interstitial pulmonary edema was noted in 11 patients (11/806; 1.4 %) and diuretic therapy was started in all of those cases. A chest drainage tube was placed after CTA in 6 patients with extensive pleural effusion (6/806; 0.7 %) and in 1 patient with coincidentally detected pneumothorax (1/806; 0.1 %). In 5 patients (5/806; 0.6 %) pulmonary embolism was diagnosed and anticoagulation therapy was initiated in all of them. Reticular opacities suspicious of pulmonary fibrosis were detected in 4 patients (4/806; 0.5 %) and further examination was recommended. Relevant non-malignant abdominal findings were hydronephrosis grade 2 or higher in 4 patients (4/806; 0.5 %). 2 patients (2/806; 0.2 %) had an acute rib fracture. In 1 patient (1/806; 0.1 %) acute spondylodiscitis was diagnosed and subsequently treated with systemic antibiotics.

Malignant findings

The most frequent potentially malignant findings were non-calcified solid pulmonary nodules (59/806; 7.3 %). High-risk patients with nodules of ≤ 6 mm, > 6 – 8 mm and > 8 mm had follow-up data available in 40.0 % (2/5), 58.1 % (18/31) and 73.9 % (17/23)

▶ **Table 2** Non-significant extravascular findings.

▶ **Tab. 2** Klinisch nicht relevante extravaskuläre Zufallsbefunde.

region	findings	n	%
thyroid gland	goiter	227	28.2
chest wall	lipoma/atheroma/scars	10	1.2
breast	gynecomastia	24	3.0
	calcifications, fibroadenoma, dense tissue	8	1.0
mediastinum/hilum	hiatal hernia	36	4.5
	esophageal diverticulum	1	0.1
	tracheal diverticulum	1	0.1
	lymphocele	1	0.1
	lymph node calcification/fatty degeneration	23	2.9
pleura	pleural effusion (small, no treatment)	70	8.7
	pleural fibrosis and calcification	17	2.1
lung	pulmonary emphysema	182	22.6
	subsegmental atelectasis	167	20.7
	parenchymal scars	167	20.7
	bronchiectasis	9	1.1
	bronchial wall thickening (chronic bronchitis)	3	0.4
	pulmonary cavitation	1	0.1
	pneumatocele	3	0.4
	non-calcified solid nodule ≤ 4 mm (low-risk patient)	26	3.2
	calcified granuloma	52	6.5
liver	fatty liver	44	5.5
	calcification	12	1.5
	hepatomegaly	3	0.4
	hepatic cysts	103	12.8
	hepatic hemangioma	59	7.3
biliary tract	cholelithiasis	76	9.4
	porcelain gallbladder	3	0.4
	aerobilia	2	0.2
pancreas	pancreatic duct calcifications	7	0.9
	pancreatic duct dilatation	19	2.4
	pancreatic pseudocyst	14	1.7
	pancreatic lipomatosis	51	6.3
spleen	accessory spleen	54	6.7
	calcification	7	0.9
	cyst	18	2.2
	splenosis	1	0.1
	infarction	4	0.5
gastrointestinal tract	duodenal/jejunal diverticula	6	0.7
	colonic diverticulosis	202	25.1
peritoneal cavity	ascites	10	1.2
mesentery	mesenteric panniculitis	6	0.7
retroperitoneal space	lipoma	1	0.1

▶ **Table 2** (Continuation)

region	findings	n	%
adrenal gland	adrenal hyperplasia	74	9.2
	adenoma	44	5.5
	calcification	5	0.6
kidney	renal cysts	270	33.5
	renal parenchymal thinning	57	7.1
	renal infarction	35	4.3
	horseshoe kidney	1	0.1
urinary tract	urinary calculi (without obstruction)	19	2.4
	bladder diverticulum	4	0.5
abdominal wall	abdominal wall hernia	36	4.5
male reproductive system	prostatic hyperplasia	87	10.8
	prostatic calcification	57	7.1
	hydrocele	4	0.5
	varicocele	1	0.1
	inguinal hernia	3	0.4
female reproductive system	uterine fibroid	20	2.5
	ovarian cyst	10	1.2
groin	seroma	2	0.2
musculoskeletal	degenerative spine disease/arthrosis	433	53.7
	healed fracture	79	9.8
	benign skeletal lesions (cyst/osteoma)	59	7.3
	intramuscular lipoma	4	0.5

of cases, respectively (▶ **Table 3**). Lung cancer was diagnosed in 10 patients (10/806; 1.2 %) (▶ **Fig. 1**).

Overall, a previously unknown malignant tumor was diagnosed in 23 (2.9 %) patients. The incidence of lung cancer was followed in descending order by colorectal cancer (3/806; 0.4 %), lymphoma/leukemia (2/806; 0.2 %), prostate cancer (2/806; 0.2 %) and other malignancies shown in ▶ **Table 3**. In 9 patients (9/806; 1.1 %) metastases were found simultaneously. Malignant tumors were detected slightly more often in men than in women (3.5 % versus 0.9 %; p = .055), but the association was not significant. Patients with a newly diagnosed malignant tumor were significantly older than patients without a malignant tumor (72.3 ± 8.2 years vs. 67.5 ± 11.3 years; p = .0432) (▶ **Fig. 2**).

Discussion

Computed tomography angiography is a primary imaging modality for planning endovascular and surgical procedures in patients with vascular diseases [1, 2]. Especially for the planning of aortic stent grafts, a preoperative CTA scan is mandatory. However, scans of the entire aorta and the great arteries arising from the aorta include almost the whole chest, abdomen, and pelvis. Therefore, radiologists have to be aware of unexpected clinically relevant extravascular abnormalities. This information is available without an additional X-ray dose. Detection of relevant pathologies may lead to further diagnostics and treatment in succession.

Nearly all patients showed one or more unsuspected extravascular finding on preoperatively performed whole-body CTA. A significant finding was detected in one in four patients. Most significant extravascular findings were located in the thorax (60.5 %). Those were pulmonary infection, interstitial pulmonary edema, extensive pleural effusion and pulmonary embolism. Lung cancer was first diagnosed in 1.2 % of the patients.

Our results are in concordance to the results published by Indes and colleagues, who reviewed the course of 82 vascular patients undergoing whole-body CTA before and after endovascular aneurysm repair (EVAR) [5]. At least one incidental finding was detected in 89 % of their patients, and 19 % were clinically significant. The most common clinically significant incidental finding was the presence of a lung mass in 4.8 % of the patients. In contrast to our results, they detected a slightly higher chance of finding a clinically significant result in women. Furthermore, there was no significant difference between the two groups with respect to patient age (76.1 vs. 75.5 years). However, their patient population was tenfold smaller than in our study. Our results are not comparable to those studies with vascular patients that analyze CT scans of the abdominal aorta and lower extremities only [6 – 9].

▶ **Table 3** Clinically significant extravascular findings.

▶ **Tab. 3** Klinisch relevante extravaskuläre Zufallsbefunde.

region	clinically significant extravascular finding	no. of patients		follow-up studies performed		relevant diagnosis/therapeutic consequences		
		n	(%)	n	(%)	n	(%)	
chest wall	lesion suspected of malignancy	1	(0.1)	1	(0.1)	0	–	–
breast	lesion suspected of malignancy	2	(0.2)	1	(0.1)	0	–	–
mediastinum & hilum	mass/lymph node enlargement (>1 cm)	17	(2.1)	11	(1.4)	1	(0.1)	leukemia
						1	(0.1)	lymphoma
						1	(0.1)	thymus cancer
						3	(0.4)	metastasis
	thickening of the esophagus wall	7	(0.9)	4	(0.5)	4	(0.5)	esophagitis (proton-pump inhibitors)
pleura	extensive pleural effusion	6	(0.7)	6	(0.7)	6	(0.7)	pleural drainage
	pneumothorax	1	(0.1)	1	(0.1)	1	(0.1)	pleural drainage
lung	interlobular septal thickening	11	(1.4)	11	(1.4)	6	(0.7)	lung edema (diuretic)
	filling defects in pulmonary artery	5	(0.6)	5	(0.6)	5	(0.6)	pulmonary embolism (anticoagulants)
	reticular opacities (fibrosis)	4	(0.5)	1	(0.1)	0	–	–
	tree in bud	4	(0.5)	4	(0.5)	2	(0.2)	infective bronchiolitis (antibiotics)
	ground glass opacity	3	(0.4)	3	(0.4)	1	(0.1)	infective pneumonia (antibiotics)
	consolidation	22	(2.7)	22	(2.7)	8	(1.0)	infective pneumonia (antibiotics)
	non-calcified solid nodule/mass							
	▪ ≤6 mm (high-risk patients)	5	(0.6)	2	(0.2)	0	–	–
	▪ 6–8 mm	31	(3.8)	18	(2.2)	1	(0.1)	metastasis
	▪ 8 mm	23	(2.9)	17	(2.1)	2	(0.2)	metastasis
						10	(1.2)	lung cancer
liver	lesion suspected of malignancy	8	(1.0)	6	(0.7)	3	(0.4)	metastasis
biliary tract	bile duct dilatation	3	(0.4)	3	(0.4)	1	(0.1)	papillary stenosis (papillotomy)
	thickening of the gallbladder wall	3	(0.4)	3	(0.4)	1	(0.1)	cholecystitis (cholecystectomy)
pancreas	lesion suspected of malignancy	6	(0.7)	3	(0.4)	0	–	–
spleen	splenomegaly	8	(1.0)	5	(0.6)	0	–	–
	lesion suspected of malignancy	2	(0.2)	1	(0.1)	0	–	–
gastro-intestinal tract	thickening of the stomach wall	2	(0.2)	2	(0.2)	1	(0.1)	neuroendocrine cancer
	thickening of the small bowel wall	2	(0.2)	1	(0.1)	0	–	–
	thickening of the large bowel wall	13	(1.6)	12	(1.5)	1	(0.1)	intestinal wall necrosis
						2	(0.1)	colorectal cancer/high-grade dysplasia
						2	(0.2)	colitis
mesentery	lymph node enlargement	5	(0.6)	3	(0.4)	1	(0.1)	metastasis

▶ **Table 3** (Continuation)

region	clinically significant extravascular finding	no. of patients		follow-up studies performed		relevant diagnosis/therapeutic consequences		
		n	(%)	n	(%)	n	(%)	
retroperitoneal space	lymph node enlargement	4	(0.5)	4	(0.5)	0	–	–
adrenal gland	lesion suspected of malignancy	9	(1.1)	7	(0.9)	1	(0.1)	metastasis
kidney	cystic lesions (≥ Bosniak IIF)	13	(1.6)	5	(0.6)	0	–	–
	solid lesions suspected of malignancy	18	(2.2)	9	(1.1)	1	(0.1)	kidney cancer
urinary tract	hydronephrosis (≥ grade II)	4	(0.6)	3	(0.5)	0		
	lesion suspected of malignancy	1	(0.1)	1	(0.1)	1	(0.1)	urethral cancer
	thickening of the bladder wall	10	(1.2)	2	(0.2)	1	(0.1)	bladder cancer
musculo-skeletal	acute fracture (rib)	2	(0.2)	2	(0.2)	0	–	medical treatment (painkiller/ pain management)
	spondylodiscitis	1	(0.1)	1	(0.1)	1	(0.1)	medical treatment (antibiotics)
	lesion suspected of malignancy (osteolytic/osteoblastic)	3	(0.4)	3	(0.4)	3	(0.4)	metastasis

In large studies, evaluating coronary artery abnormalities using electro-beam CT (EBCT) or multidetector CT (MDCT), the incidence of lung cancer was about 0.01 % to 0.4 % [10 – 14]. However, these studies may have underestimated the incidence of lung pathologies for the following reasons: Firstly, EBCT or MDCT scans of the heart were obtained with a small field of view [10, 11, 14]. Therefore, the lateral and apical aspects of the lung were not completely visualized and relevant pulmonary nodules may have been missed. Secondly, not all investigators routinely calculated a dedicated lung window [11, 14]. In our study, an axial lung window with a sharp kernel of the entire thorax was routinely calculated and displayed for further analysis. However, we believe that the main reason for the relatively high rate of lung cancer in our study was the patients' age. The vascular patients included in our study were approximately ten years older than the patients presented in the abovementioned large cardiac CT studies with an average patient age below 60 years [10 – 12].

Regarding the patients' age, our study population is rather comparable to studies with patients undergoing CTA before transcatheter aortic valve implantation (TAVI) [7, 15 – 17]. In the TAVI trial of Ben-Dor et al., the overall rate of unexpected malignancy was 4.2 %. 1.2 % of the patients were diagnosed with lung cancer [7].

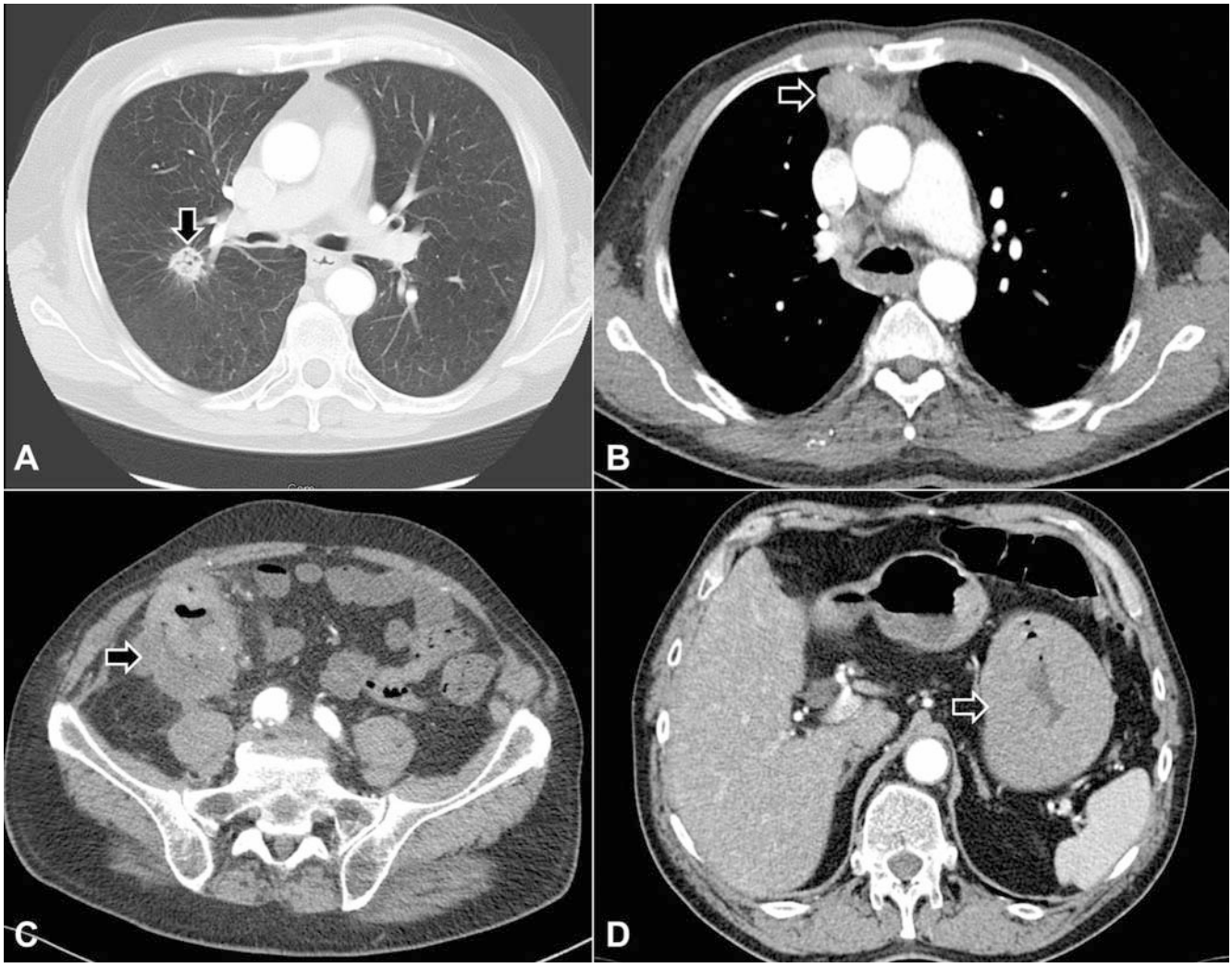
The limitations of our study are as follows: We only reviewed the official radiological reports and no secondary evaluation of the original CT scans was performed. Due to partially incomplete follow-up, we may have underestimated the prevalence of malignant diseases. This is critical in patients with non-calcified pulmonary nodules, since these findings need follow-up imaging for up to 24 months. However, 17 of 23 patients (74 %) with a pulmonary nodule > 8 mm had complete follow-up available. Another weakness is the thickness of 5 mm for our standard lung window reconstruction that may have led to underestimation of small pulmonary nodules. Furthermore, the lack of a portal-venous phase in our standard CT angiography protocol due to dose restrictions may impair the diagnosis of masses in the parenchymatous abdominal organs, especially in the liver. Finally, we did not analyze the rate of alteration in treatment plans, delay of treatment, and cost increase due to unexpected findings as other studies did [8, 15].

Conclusion

With the increasing number of surgical and interventional vascular procedures, preoperatively performed CTA examination of the body in elderly vascular patients will reveal multiple unexpected extravascular findings that might change the course of the patient. This underlines the importance of a thorough and comprehensive analysis of every CTA scan of this patient population by a senior radiologist. Especially noteworthy are malignant tumors of the lung, as this tumor entity had the highest incidence (10/806; 1.2 %) in our study population comprising patients with vascular diseases.

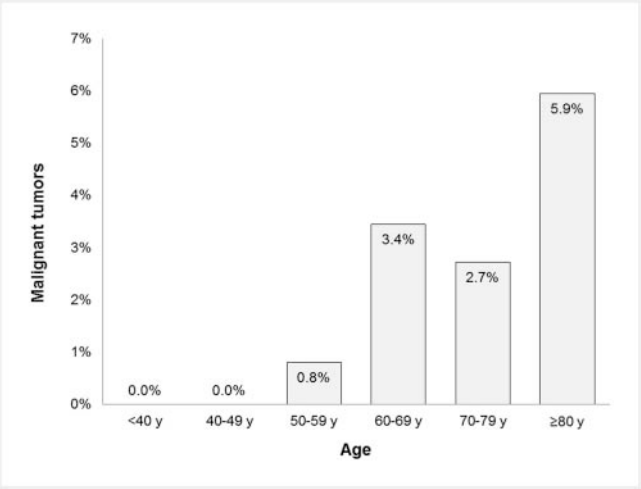
Conflict of Interest

The authors declare that they have no conflict of interest.



▶ **Fig. 1** **A** CTA of a 62-year-old male patient with aortoiliac occlusive disease. Reconstruction of the lung showed an unsuspected spiculated mass in the upper lobe of the right lung (arrow). Bronchial biopsy revealed the diagnosis of a bronchial carcinoma. **B** CTA of a 62-year-old male patient with suspected aortic aneurysm. On axial images of the thorax, a suspicious mass in the anterior portion of the mediastinum was detected (arrow) and a thymus cancer was later diagnosed via biopsy. **C** Axial CTA of a 73-year-old male patient with Marfan syndrome and aortic dissection showed thickening of the cecum wall. Endoscopic biopsy confirmed the diagnosis of colorectal cancer. **D** Axial slices of a 61-year-old male patient with thickening of the gastric wall due to neuroendocrine cancer.

▶ **Abb. 1** **A** CTA eines 62-jährigen, männlichen Patienten mit aortoiliakaler Verschlusskrankheit. Die Lungenrekonstruktion zeigte unerwartet einen spikulierten Herd im rechten Oberlappen (Pfeil). Eine anschließende Biopsie bestätigte die Diagnose eines Bronchialkarzinoms. **B** CTA eines 62-jährigen, männlichen Patienten mit Verdacht auf ein Aortenaneurysma. Auf axialen Schichten des Thorax zeigte sich eine suspekte Raumforderung im anterioren Mediastinum (Pfeil), im Verlauf wurde die Diagnose eines Thymuskarzinoms mittels Biopsie gestellt. **C** Die axiale Schicht einer CTA eines 73-jährigen, männlichen Patienten mit Marfan-Syndrom und Aortendissektion zeigte eine Verdickung der Zökum-Wand. Die endoskopische Biopsie bestätigte die Diagnose eines kolorektalen Karzinoms. **D** Axiale Schicht einer CTA eines 61-jährigen, männlichen Patienten mit einer Verdickung der Magenwand aufgrund eines neuroendokrinen Karzinoms.



▶ **Fig. 2** Incidence of malignant tumors in 806 patients depending on age.

▶ **Abb. 2** Inzidenz von Malignomen in 806 Patienten, abhängig von der Altersgruppe.

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