Original Article

Prevalence of concomitant aortic disease and lung cancer: an exploratory study

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Background: Lung cancer and aortic disease share multiple risk factors. The co-presence of both diseases defines a peculiar type of patient who needs a specific protocol of treatment and follow-up. The aim of our study was to evaluate the prevalence of aortic disease in a population of patients with a diagnosis of primary lung cancer.

Methods: A retrospective, single center analysis of all patients admitted to the Thoracic Surgery Unit from January 2015 to January 2021. Demographic and baseline characteristics were retrieved from hospital electronic charts. All patients were screened for aortic disease, reviewing thoraco-abdominal Computed Tomography with contrast medium administration performed for oncological reasons. A cancer-free control group was obtained for comparison. Multilinear regression analysis was performed to identify the risk factors for the presence of aortic disease.

Results: A total of 264 patients were preliminarily identified. After reviewing for exclusion criteria, a total of 148 patients were included in the analysis. Most of the patients were male (62.2%) with a mean age of 71±8.7 years. Cardiovascular risk factors were extensively prevalent in the population study. The incidence of aortic pathologies in the group of patients suffering from primary lung cancer was 27% (40 patients). The majority presented thoracic aortic aneurysms (11.5%). Comparison between the lung cancer group and the control group highlighted a substantial difference in terms of aortic disease prevalence (27% *vs.* 2.9%; P<0.0001). The regression analysis revealed that coronary artery disease [odds ratio (OR) 4.6988, P=0.001], peripheral artery disease (OR 7.7093, P=0.002), hypertension (OR 4.0152, P=0.03) and history of previous non-aortic vascular surgery procedures (OR 6.4509, P=0.003) were risk factors for aortic disease in patients with primary lung cancer.

Conclusions: Patients with lung cancer have a high prevalence of aortic disease, defining a peculiar subset of patients who deserve a specific protocol of treatment and follow-up. Further studies are needed to define a dedicated standardized multidisciplinary approach.

Keywords: Aortic disease; risk factors; lung cancer; aneurysm

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Introduction

Lung cancer represents one of the most prevalent oncological diseases in both sexes. Despite the reduction of its incidence, it continues to be the leading cause of cancer-related deaths in USA.

On the other hand, atherosclerotic disease, in its various declinations, accounts for nearly 18 millions of deaths each year (1). Several studies proved the existence of a significant association between lung cancer and atherosclerotic diseases, showing that lung cancer patients have an augmented risk of 89% of developing coronary artery disease (CAD) during their life compared to no lung cancer patients (2,3). Different mechanisms have been advocated to explain the link between atherosclerotic disease and lung cancer including an increased oxidative cellular stress and chronic inflammation (4). Moreover, the two diseases share a significant number of risk factors, as cigarette smoking, that is essentially the most important common risk factor for both diseases with a dose-response relationship. In fact, smoking habit is the leading modifiable risk factor in the development of lung cancer and also plays a central role in the genesis of peripheral vascular disease. In addition, the wide range of aortic diseases, represented by aneurysm, dissection, penetrating aortic ulcers (PAU) and intramural hematoma (IMH) have been also strongly related with smoking habit.

This study aims to evaluate the prevalence of aortic disease in a peculiar cohort of patients characterized by the diagnosis of primary lung cancer, identifying the risk factors that could be associated with the copresence of aortic disease, comparing them to a control group of cancer-free group. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1547/rc).

Highlight box

Key findings

- Patients with lung cancer have a high prevalence of aortic disease.

What is known and what is new?

- Lung cancer and aortic disease share multiple risk factors. The co-presence of both diseases defines a peculiar type of patient who needs a specific protocol of treatment and follow-up.
- Coronary artery disease, peripheral artery disease, hypertension and history of previous non-aortic vascular surgery procedures, were risk factors for aortic disease.

What is the implication, and what should change now?

- The definition a peculiar subset of patients who deserve a specific protocol of treatment and follow-up.

Methods

We conducted a single center retrospective case-control study from January 2015 to January 2021.

All patients admitted to the Thoracic Surgery Department of the University of Siena with a diagnosis of primary lung cancer were firstly included in the study.

Patients with pulmonary secondarism were excluded from analysis as the aim of our study was focused on primary lung neoplasms, which shares similar pathophysiologic mechanisms with the development of aortic disease.

Demographic and risk factor data as well as information about lung cancer stage and histological features were obtained for all patients. CAD, hypertension, diabetes mellitus, chronic obstructive pulmonary disease (COPD), renal disease (chronic renal insufficiency defined by serum creatinine >1.2 mg/dL), smoking history (any current or past regular use of tobacco), congestive heart failure, history of cerebrovascular events (stroke and/or transient ischemic attacks), history of previous cancer, dyslipidemia and atrial fibrillation were considered as comorbidities. In addition, previous non-aortic vascular surgery procedures were recorded and included in the list of variables of interest. An exploratory descriptive analysis was also made comparing smokers to no-smokers group due to the high relevance of smoking habit in the pathogenesis of both diseases.

The whole-body-computed tomography angiography (CTA) scans performed at the time of lung tumor diagnosis were reviewed. The thoracic and abdominal aorta was examined for different diseases, and measurements were taken at standard locations referring to Ishimaru's aortic zones (thoracic ascending aorta, aortic arch, thoracic descending aorta, supraceliac and infrarenal aorta) (5) including the maximum diameter of the aorta measured perpendicular to the central line, and the vessel wall integrity for diagnosis of aortic dissection, IMH or PAU. Aneurysms were differently defined in relation to the location of the aneurysm respect to the diameter of the closest healthy aorta. An aneurysm was defined as a permanent dilatation of the entire wall of the aorta with a maximum diameter greater than 50% than the maximum diameter of the closest healthy aorta.

Aortic dissection was defined as a life-threatening condition due to a tear in the intimal layer of the aorta or bleeding within the aortic wall, resulting in the separation

of the different layers of the aortic wall, creating a false lumen. Aortic dissections were distinguished in terms of location, using Stanford classification (types A and B) and in symptomatic and asymptomatic in term of clinical condition.

IMH was defined according to European Society Vascular Surgery clinical practice guidelines as the presence of blood within the aortic wall without intimal disruption or an identifiable entry point on imaging (6). PAU was defined as an ulceration of an aortic atherosclerotic plaque penetrating through the internal elastic lamina into the media (7-9).

Patients who were discovered to have had prior vascular interventions at the level of aortic district were classified as positive and allocated in the group of the treated aortic pathology.

A control group of patients having a thorax-abdominal computed tomography (CT) scan for non-cancer-related reasons admitted to the thoracic surgery unit were reviewed for comparison. These patients were selected randomly from the same time period as the lung cancer group with age and sex similar data. Two experienced vascular surgeons performed a blinded imaging analysis. The primary outcome was to evaluate the prevalence of aortic disease in primary lung cancer patients. Secondary outcome was to evaluate the impact of smoking habit on the copresence of lung cancer and aortic disease. In addition, a secondary aim was to identify the risk factors that could be associated with the copresence of aortic disease, comparing them to a control group of cancer-free group.

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The ethical committee of the AOUS Le Scotte di Siena was informed of the no-experimental design of the retrospective investigation and endorsed the study. An informed consent waiver was approved by the ethical committee due to the retrospective design of this study based on patient records.

Statistical analysis

For both study groups, the proportion and 95% confidence intervals (CIs) for aortic disease prevalence were calculated. Comparison between groups was performed using Pearson χ^2 test.

Inter- and intra-observer variability in imaging analysis for detection of aortic pathology was assessed using the Cohen's kappa test of concordance. A k value of 0.61–0.80 and 0.81–1.0 indicated good agreement and excellent agreement, respectively. Multivariable binary logistic regression was used to evaluate the associations of multiple variables on the presence of aortic disease.

Results

A total of 264 patients were preliminarily identified using the aforementioned criteria. between these patients, 116 had secondary pulmonary metastatic disease or insufficient data to conduct the study and were excluded from further analysis. The remaining cohort of 148 patients fulfilled the criteria and patients were all included in the subsequent analysis. Most patients were male (62.2%) with a mean age of 71±8.7 years. Cardiovascular risk factors were extensively prevalent in our sample. Nearly 75% of patients were current or former smokers, 67.6% suffered from hypertension and 50.7% from dyslipidemia. At the time of the study seven (4.7%) patients had already undergone an aortic intervention. Five had an abdominal aortic aneurysm (AAA) fixed previously [4 endovascular aneurysm repair (EVAR), 1 open repair], two had a previous thoracic endovascular aortic repair. Twenty-seven patients (18.2%) had previous non aortic vascular procedures.

Full details of baseline population characteristics are listed in *Table 1*.

For the control group, a total of 102 patients were identified.

Tumors' staging and histological types are shown in *Table 2*. The majority of patients had diagnosis of adenocarcinoma (70%, n=103). The 53.5% of patients had a stage I lung cancer.

In the lung cancer population, 40 patients (27%) had an aortic lesion. The majority was represented by thoracic aortic aneurysms (11.5%) and consecutively PAU (10.1%).

Mean aortic diameter of the thoracic aneurysms was 4.3±0.6 cm.

Aortic dissections were 10 (6.7%), all of them were type B asymptomatic chronic dissection with no indication for treatment. Only two patients with thoracic aortic aneurysm and one patient with AAA reached indications for treatment; all these patients underwent endovascular repair. Twelve patients were diagnosed of an infrarenal AAA with a mean diameter of 3.9±0.7 cm.

Descriptive analysis between lung cancer group and control group highlighted a substantial difference in term of aortic disease prevalence (27% *vs.* 2.9%; P<0.0001) (full details in *Table 3*).

Lung cancer patients with concomitant aortic disease

Table 1 Baseline characteristics of the study population

Variables	Population study (N=148)
Age (years), mean ± SD	71±8.7
Male, n (%)	92 (62.2)
COPD, n (%)	27 (18.2)
CAD, n (%)	34 (23.0)
CHF, n (%)	20 (13.5)
PAD, n (%)	11 (7.4)
Diabetes mellitus, n (%)	25 (16.9)
Dyslipidaemia, n (%)	75 (50.7)
Active smoker, n (%)	36 (24.3)
Former smoker, n (%)	81 (54.7)
CKD, n (%)	21 (14.2)
Hypertension, n (%)	100 (67.6)
AF, n (%)	16 (10.8)
Previous vascular surgery procedures, n (%)	27 (18.2)
Drugs assumption, n (%)	
Single antiplatelet	56 (37.8)
Dual antiplatelet	7 (4.7)
Anticoagulants	61 (41.2)
Statin	12 (8.1)
Aortic disease, n (%)	
Thoracic aortic aneurysms	17 (11.5)
Abdominal aortic aneurysms	12 (8.1)
Thoracic PAU	15 (10.1)
Aortic dissection	10 (6.8)
Thoracic IMH	2 (1.4)

SD, standard deviation; COPD, chronic obstructive pulmonary disease; CAD, coronary artery disease; CHF, chronic heart failure; PAD, peripheral artery disease; CKD, chronic kidney disease; AF, atrial fibrillation; PAU, penetrating aortic ulcer; IMH, intramural hematoma.

Table 2 Oncological baseline features

Cancer stage and histology	Total population (N=148)
Stage I, n (%)	79 (53.5)
Stage II, n (%)	18 (12.2)
Stage III, n (%)	32 (21.6)
Stage IV, n (%)	19 (12.8)
Adenocarcinoma, n (%)	103 (69.6)
Squamous, n (%)	31 (20.9)
Small cell/neuroendocrine, n (%)	8 (5.4)
Others, n (%)	6 (4.1)

were more likely to be male (90.0% *vs.* 51.9%, P<0.0001), to have COPD (27.5% *vs.* 14.8%, P=0.009), coronary (40.0% *vs.* 16.7%, P=0.002) and peripheral artery disease (PAD) (17.5% *vs.* 3.7%, P=0.009), congestive heart failure (32.5% *vs.* 6.5%, P=0.0001), diabetes (42.5% *vs.* 7.4%, P=0.0001), hypertension (87.5% *vs.* 59.3%, P=0.0014) and atrial fibrillation (9.3% *vs.* 5.5%, P=0.002). In addition, aortic disease patients were more likely to had previous non-aortic vascular surgery procedures (35.0% *vs.* 12.0%, P=0.003). Cancer stage I was more frequent in aortic disease subgroup (75.0% *vs.* 45.4%, P=0.001) while stage IV was more frequent in non-aortic disease patients (2.5% *vs.* 16.6%, P=0.01). No differences between the two groups were highlighted in terms of cancer histological type. Full details are listed in *Table 4*.

Due to the important influence of smoking habit on both lung cancer and aortic degenerative disease, we also divided the population study regarding the smoking habit. The results are shown in *Table 5*. Smokers were more likely to be male and had COPD. No other statistically differences were highlighted. Also aortic disease, which was more frequent in smokers groups than no-smokers group (30.8% *vs.* 12.9%), did not reach statistically significance (P=0.07). Multivariable binary logistic regression highlighted that CAD [odds ratio (OR) 4.6988, P=0.001], PAD (OR 7.7093, P=0.002), hypertension (OR 4.0152, P=0.03) and previous non-aortic vascular surgery procedures (OR 6.4509, P=0.003) were risk factors of aortic disease in patients with lung cancer. Full details are listed in *Table 6*. *Figure 1* represents the sensitivity and specificity of logistic analysis performed. The area under the curve was 0.842 with specificity and sensitivity values of 0.887 and 0.452, respectively.

Discussion

The present study aimed to investigate the prevalence of aortic disease in a specific population characterized by the presence of primary lung cancer. In our experience, oncological patients represent a peculiar cohort in which

Table 3 Comparison of demographic data between lung cancer and control groups

Variables	Lung cancer (N=148)	Controls (N=102)	P value
Age (years), mean ± SD	71±8.7	71±11.8	0.71
Male, n (%)	92 (62.2)	74 (72.5)	0.12
COPD, n (%)	27 (18.2)	10 (9.8)	0.07
CAD, n (%)	34 (23.0)	13 (12.7)	0.04
CHF, n (%)	20 (13.5)	5 (4.9)	0.03
PAD, n (%)	11 (7.4)	6 (5.9)	0.81
Diabetes mellitus, n (%)	25 (16.9)	10 (9.8)	0.13
Dyslipidemia, n (%)	75 (50.7)	16 (15.6)	0.0001
Active smoker, n (%)	36 (24.3)	10 (9.8)	0.004
Former smoker, n (%)	81 (54.7)	3 (2.9)	0.0001
CKD, n (%)	21 (14.2)	10 (9.8)	0.32
Hypertension, n (%)	100 (67.6)	42 (41.2)	0.0001
AF, n (%)	16 (10.8)	6 (5.9)	0.25
Previous non-aortic vascular surgery procedures, n (%)	27 (18.2)	12 (11.8)	0.22
Drugs assumption, n (%)			
Single antiplatelet	56 (37.8)	20 (19.6)	0.002
Dual antiplatelet	7 (4.7)	6 (5.9)	0.71
Anticoagulants	61 (41.2)	9 (8.8)	0.0001
Statin	12 (8.1)	15 (14.7)	0.14
Aortic disease, n (%)			
Thoracic aortic aneurysms	17 (11.5)	0	<0.0001
Abdominal aortic aneurysms	12 (8.1)	1 (1.0)	0.01
Thoracic PAU	15 (10.1)	1 (1.0)	0.003
Aortic dissection	10 (6.8)	0	0.006
Thoracic IMH	2 (1.4)	1 (1.0)	>0.99

SD, standard deviation; COPD, chronic obstructive pulmonary disease; CAD, coronary artery disease; CHF, chronic heart failure; PAD, peripheral artery disease; CKD, chronic kidney disease; AF, atrial fibrillation; PAU, penetrating aortic ulcer; IMH, intramural hematoma.

aortic disease is highly prevalent.

The link between oncological and aortic disease is well established, not only for lung cancer.

The pathophysiological mechanism is still to be entirely clarified. Certainly, the exposure to common risk factors plays an important role in the development of these two pathologies.

The primary cause of the development of aortic disease is atherosclerosis, that is currently defined as a systemic condition. Contemporary to the aorta, atherosclerotic lesions could be localized in several different districts determining a direct and indirect narrowing effect towards the perfusion of different organs (10). In addition, atherosclerosis, and AAA are linked to high level of systemic inflammation and widespread of different types of inflammatory elements. Inflammation plays a key role in tumor development. Several studies have highlighted that some pro-inflammatory cells are responsible for tumor growth and spread, due to the role they have in the induction of immunosuppression (11-13). A

Table 4 Comparison of demographic data between aortic disease patients and non-aortic disease patients

Variables	Aortic disease patients (N=40)	Non-aortic disease patients (N=108)	P value
Age (years), mean ± SD	73.6±6.7	70.8±9.4	0.07
Male, n (%)	36 (90.0)	56 (51.9)	<0.0001
COPD, n (%)	11 (27.5)	16 (14.8)	0.009
CAD, n (%)	16 (40.0)	18 (16.7)	0.002
CHF, n (%)	13 (32.5)	7 (6.5)	0.0001
PAD, n (%)	7 (17.5)	4 (3.7)	0.009
Diabetes mellitus, n (%)	17 (42.5)	8 (7.4)	0.0001
Dyslipidemia, n (%)	25 (62.5)	49 (45.4)	0.09
Active smoker, n (%)	10 (25.0)	25 (23.1)	0.82
Former smoker, n (%)	26 (65.0)	55 (50.9)	0.14
CKD, n (%)	8 (20.0)	13 (12.0)	0.03
Hypertension, n (%)	35 (87.5)	64 (59.3)	0.001
AF, n (%)	10 (9.3)	6 (5.5)	0.002
Previous non-aortic vascular surgery procedures, n (%)	14 (35.0)	13 (12.0)	0.003
Drugs assumption, n (%)			
Single antiplatelet	18 (45.0)	38 (35.1)	>0.99
Dual antiplatelet	2 (5.0)	5 (4.6)	>0.99
Anticoagulants	4 (10.0)	8 (7.4)	0.09
Statin	21 (52.5)	40 (37.0)	0.07
Cancer stage, n (%)			
Stage I	30 (75.0)	49 (45.4)	0.001
Stage II	3 (7.5)	15 (13.9)	0.42
Stage III	6 (15.0)	26 (24.1)	0.16
Stage IV	1 (2.5)	18 (16.6)	0.01
Cancer type, n (%)			
Adenocarcinoma	26 (65.0)	77 (71.3)	0.50
Squamous	11 (27.5)	20 (18.5)	0.25
Small cell/neuroendocrine	1 (2.5)	7 (6.5)	0.52
Others	2 (5.0)	4 (3.7)	0.66

SD, standard deviation; COPD, chronic obstructive pulmonary disease; CAD, coronary artery disease; CHF, chronic heart failure; PAD, peripheral artery disease; CKD, chronic kidney disease; AF, atrial fibrillation.

straightforward example is represented by the results of the CANTOS study (canakinumab anti-inflammatory thrombosis outcomes study) in which the anti-inflammatory therapy determined by the canakinumab (modulator of IL1 pathway) significantly reduced the incidence of lung cancer (14). Different biological and molecular pathways were extensively studied to understand the high co-prevalence of aortic disease and lung cancer. It was

Table 5 Comparison of demographic data between smokers and no-smokers patients

Variables	Smokers (N=117)	No-smokers (N=31)	P value
Age (years), mean ± SD	70±6.7	71±9.5	0.52
Male, n (%)	86 (73.5)	6 (19.4)	0.0001
COPD, n (%)	27 (23.1)	0	0.001
CAD, n (%)	27 (23.1)	7 (22.6)	>0.99
CHF, n (%)	14 (12.0)	6 (19.4)	0.40
PAD, n (%)	11 (9.4)	0	0.14
Diabetes mellitus, n (%)	18 (15.4)	7 (22.6)	0.45
Dyslipidemia, n (%)	60 (51.3)	15 (48.4)	0.81
CKD, n (%)	19 (16.2)	2 (6.5)	0.24
Hypertension, n (%)	80 (68.4)	20 (64.5)	0.60
AF, n (%)	10 (8.5)	6 (19.4)	0.14
Previous non-aortic vascular surgery procedures, n (%)	24 (20.5)	3 (9.7)	0.22
Drugs assumption, n (%)			
Single antiplatelet	46 (39.3)	10 (32.3)	0.56
Dual antiplatelet	7 (6.0)	0	0.34
Anticoagulants	10 (8.5)	6 (19.4)	0.13
Statin	49 (41.9)	12 (38.7)	0.60
Aortic disease, n (%)	36 (30.8)	4 (12.9)	0.07

SD, standard deviation; COPD, chronic obstructive pulmonary disease; CAD, coronary artery disease; CHF, chronic heart failure; PAD, peripheral artery disease; CKD, chronic kidney disease; AF, atrial fibrillation.

confirmed the significance of the expression of an enzyme that catalyzes the metabolism of various drugs and substances, the cytochrome P450 (CYP). Specifically, the CYP 2A13 was found to be downregulated in lung adenocarcinoma (15). The enzyme catalyzes the activation of one of the most important tobacco carcinogens, the 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone, which suggests a link between CYP2A13 and lung adenocarcinoma (16). CYPs are also associated with atherosclerosis; in fact, various reactive oxygen species are created by the cytochrome family and their action is related also to the inhibition of vasal relaxation obtained by nitric oxide and the elevated activity of the redox-sensitive transcription factor [nuclear factor-kB (NF-κB)] (17). The NF-κB plays an essential role in the inflammatory pathways and in the atherosclerosis development due to its contributing to inflammatory response and cytokines consequently CYP family production (18). However, the link between vascular and lung cancer diseases is also strongly associated to exposure of common risk factors. Cigarette smoke is essentially the most important risk factor for both diseases. Smoking habit and lung cancer development was firstly described in 1950 (19). From that point, an enormous amount of data confirmed not only this specific link, but also the existence of a causative relationship between smoke and other types of cancer as gastrointestinal, larynx, and bladder. Aneurysmal diseases have also a direct link with smoking habits. Additionally, the duration of exposure seems to have a direct impact on the disease (20,21).

Our analysis confirms that lung cancer patients represent a very complex cohort of patients with higher prevalence of aortic disease compared to a non-neoplastic population. A recent paper by Wiles *et al.* has also confirmed that lung cancer patients have a higher prevalence of AAA respect to control group (11.1% *vs.* 2%), confirming also a direct correlation with the number of smoking habits and smoking-pack years. Patients with positive smoking history

Table 6 Multivariable binary logistic regression of several risk factors on the presence of aortic disease

Variables	B coefficient	SE	95% CI	OR	P value
Age	0.0124	0.0293	−0.045 to 0.069	1.1025	0.67
Male	1.8447	0.7150	0.0433 to 3.2461	6.3259	0.01
COPD	0.3964	0.5538	−0.6891 to 1.4818	1.4864	0.47
CAD	1.5473	0.6106	0.3505 to 2.7441	4.6988	0.001
CHF	0.4521	0.7610	−0.7401 to 1.6301	1.197	0.37
PAD	2.0424	0.8916	0.2949 to 3.7900	7.7093	0.002
Diabetes mellitus	1.4390	0.5393	−0.6419 to 2.6158	2.5691	0.26
Dyslipidemia	−0.5389	0.7731	−2.0541 to 0.9763	0.5834	0.48
Active smoker	1.1138	0.7214	−0.3002 to 2.5278	3.0460	0.12
Former smoker	0.5594	0.6301	−0.6754 to 1.7943	1.7497	0.37
CKD	-0.4840	0.6726	−1.8023 to 0.8343	0.6163	0.47
Hypertension	1.3901	0.6465	0.1230 to 2.6572	4.0152	0.03
AF	1.6982	0.6410	−0.5639 to 1.8461	1.2397	0.49
Previous non-aortic vascular surgery procedures	1.8642	0.6230	0.6432 to 3.0852	6.4509	0.003
Drugs assumption					
Single antiplatelet	−0.5940	0.5671	−1.7506 to 0.5175	0.5521	0.29
Dual antiplatelet	−2.0688	1.1569	−4.3344 to 0.2007	0.1266	0.07
Anticoagulants	−1.7610	0.5196	−0.5159 to 1.8241	1.5291	0.58
Statin	−0.2716	0.7235	−1.6897 to 1.1465	0.9622	0.70
Cancer stage	0.2191	0.5891	−0.4591 to 0.9371	0.1916	0.73
Cancer type	1.2719	0.5184	−1.5971 to 1.3190	1.4917	0.39

SE, standard error; CI, confidence interval; OR, odds ratio; COPD, chronic obstructive pulmonary disease; CAD, coronary artery disease; CHF, chronic heart failure; PAD, peripheral artery disease; CKD, chronic kidney disease; AF, atrial fibrillation.

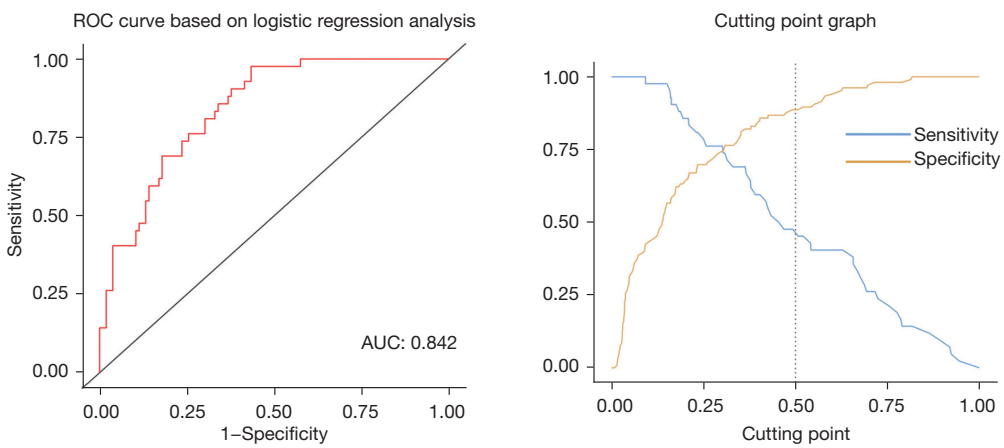

Figure 1 ROC curve and cutting point graph of linear regression analysis. AUC, area under the curve; ROC, receiver operating characteristic.

were more likely than no-smokers to have AAA (11.9% *vs.* 2.2%, P=0.0047) (22). In addition, also women had a high prevalence of AAA (4.6%). In our analysis smoking habit was related with a higher incidence of aortic disease respect to no-smokers even if the difference did not reach statistical significance (30.8% *vs.* 12.9%).

As highlighted by the regression analysis, CAD, PAD, previous non-aortic vascular surgery procedures and hypertension represent risk factors for aortic disease development suggesting that this subset of patients has a multi-level and aggressive atherosclerotic disease. Clearly, these patients need a particular attention regard treatment options and timing, and for the definition of dedicated follow-up protocols.

Notably, the presence of a diseased aorta becomes more important if the patient require radiation therapy for the treatment of lung cancer. In fact, mediastinal radiation exposure is associated with substantial risk for the subsequent development of cardiovascular disease. In addition to acute and late cardiac injury, medium and large vessel damages may occur (23). The list of manifestations could be various, from the acute rupture (24) to aortic formation of atherosclerotic plaques (25) till the development of a "porcelain aorta" (26). In light of this, meticulous attention and evaluation of the aortic baseline condition is important during the patient's follow-up. The correct identification of such patients by a dedicated multidisciplinary group may help defining standardized protocol of treatment, especially in terms of invasiveness and timing, and follow-up. Due to the higher incidence of aortic disease in these patients, detailed investigation for vascular disease also in women must be done to make prompt diagnosis and identify fast progression of aortic disease with consecutive treatment.

Limitations

The study has some limitations. Firstly, the retrospective and single center design of the study, which made it possible to engaged only a small sample. The small number of the population study was not sufficient to really produced a prevalence study. Furthermore, it was not possible to make a correlation with the quantity of cigarettes smoked per day and the duration of the smoking habit, as we did not have all the information for the sample in question. Lastly, we did not evaluate possible relation in terms of morbidity and mortality between the two diseases. In a future study it would be interesting to evaluate the influence on survival of the association of the two pathologies, compared to the single disease (lung cancer or aortic disease).

Conclusions

Aortic disease and lung cancer share several risk factors. The prevalence of different types of aortic disease, especially located at the level of the thoracic segment of the aorta, is significantly higher respect to a population without lung neoplasms. In this perspective, the definition of dedicated protocol of treatment and follow-up is mandatory in this subset of fragile patients.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1547/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1547/dss

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1547/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The ethical committee of the AOUS Le Scotte di Siena was informed of the no-experimental design of the retrospective investigation and endorsed the study. An informed consent waiver was approved by the ethical committee due to the retrospective design of this study based on patient records.

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