

Low rates of eligibility for lung cancer screening in patients undergoing computed tomography coronary angiography

Authors

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Abstract

Incidental findings, including pulmonary nodules, on Computed Tomography Coronary Angiography (CTCA) are common. Previous authors have suggested CTCA could allow opportunistic screening for lung cancer, though the lung cancer risk profile of this patient group has not previously been established. Smoking histories of 229 patients undergoing CTCA at two tertiary hospitals were reviewed and only 25% were current or former smokers aged 55-80 years old. Less than half of this group were eligible for screening based on the PLCO_{m2012} risk model. We conclude that routine screening in the form of full thoracic field imaging, of individuals undergoing CTCA is not appropriate as it would likely result in net harm.

Keywords:

Lung cancer

Computed tomography coronary angiogram

Lung cancer screening

PLCO_{m2012}

USPSTF

NLST

Low-dose chest computed tomography

Introduction

In Australia, lung cancer is the fifth most common cancer but is the leading cause of cancer related mortality and morbidity¹. Screening patients at high risk of developing lung cancer using low-dose chest computed tomography (LDCT) has been shown to reduce mortality², however it is currently not recommended practice in Australia³. Incidental findings on computed tomography coronary angiography (CTCA) occur frequently, with pulmonary nodules being the commonest finding, and consequently some authors have proposed CTCA being used for opportunistic screening for lung cancer^{4,5}. A common indication for CTCA is evaluation of chest pain with low to intermediate pre-test probability for coronary artery disease (CAD)⁶.

However, screening patients who have low risk of lung cancer is potentially harmful and may not reduce mortality⁷. Harm can occur through over investigation of incidental findings, resulting in repeat scanning, increasing the risk of radiation induced neoplasms, over-diagnosis, and exposing patients to potential complications associated with bronchoscopy and biopsy^{8,9}. As Alfakih and Budoff note, patients who are referred for CTCA are low risk for coronary artery disease and may also be low risk for lung cancer, though this has not previously been examined¹⁰. The aim of this study is to determine the distribution of lung cancer risk of patients undergoing CTCA and the proportion who would be eligible for lung cancer screening¹¹.

Method

Data was collected prospectively from outpatient CTCA sessions at two metropolitan tertiary hospitals in Victoria, Australia, between 3rd February – 26th May 2017. All patients undergoing CTCA during the study period were prospectively screened for analysis. Patients were invited to complete the survey if they met all of the following inclusion criteria; 1) English speaking, 2) age 55-80 years old, 3) current smokers or ex-smokers, & 4) no prior lung cancer diagnosis.

The survey was self-administered. Participants who were unable to complete the survey prior to undergoing CTCA were contacted by phone to complete the questionnaire. Pack-years of smoking were calculated as follows: cigarettes per day/20 x duration of smoking in years.

Eligibility for lung cancer screening was calculated according to each of these three methods:

1. a 6-year lung cancer risk score of >1.5% using the PLCO_{m2012} risk calculator¹¹ and an age range of 55-80 years,
2. using the US Preventive Service Task Force (USPSTF)¹² criteria of 55-80 years old with more than 30 pack years smoking history in current smokers or ex-smokers who ceased smoking within the last 15 years, and
3. using the National Lung Screening Trial (NLST) criteria² of 55-74 years old with more than 30 pack years smoking history in current smokers or ex-smokers who ceased smoking within the last 15 years.

The PLCO_{m2012} risk prediction tool has previously been validated in an Australian population¹³. Participants with a PLoCO_{m2012} risk of >1.5% were categorised as high risk and those who with a risk of <1.5% were categorized as low risk.

Analysis of results was completed using Microsoft Excel (2010) and McNemar test using GraphPad (2018).

Human research ethics approval was granted by the Melbourne Health Human Research Ethics Committee (QA2016167).

Results

A total of 229 people (129 male) undergoing CTCA from both sites were assessed against the inclusion criteria. 92 people were at site one and 137 were at site two. There were 49 (21.4%) current smokers, 44 (19.2%) ex-smokers and 136 (59.4%) never-smokers.

Only 59 (26%) patients were eligible for inclusion in the study and of these, 50 (85%) completed the survey (4 non-English-speaking, 5 declined to participate). Figure 1 shows the selection process that resulted in 50 (22%, mean age 65.4±6years) participants completing the survey.

Out of the 50 55-80 year old ever-smoker participants who completed the survey, 14 were current smokers, 9 had ceased smoking within the past 15 years and 27 ceased smoking more than 15 years ago. Further details of smoking history are available in Table 1.

Using the PLCO_{m2012} model, 23 (10%) people undergoing CTCA were eligible for screening. According to both the USPSTF selection criteria and the NLST selection criteria, 14 (6.1%) participants would be eligible for lung cancer screening with LDCT, of whom 12 were also eligible using the PLCO_{m2012} risk score of >1.5% criteria. PLCO_{m2012} identified significantly more participants as eligible for screening compared to USPSTF (p=0.03).

Discussion

This is the first paper to examine the lung cancer risk profile of patients undergoing CTCA. Only 23 (10%) participants undergoing CTCA were eligible for screening using the PLCO_{m2012} risk score and an age range of 55-80 years. Using the PLCO_{m2012} lung cancer screening criteria together, with the age range from the USPSTF criteria as we have done, may confer more benefit than using the USPSTF or NLST screening criteria based on the significantly larger number of participants eligible.

The PLCO_{m2012} model has been externally validated and is more sensitive than NLST without losing specificity at identifying lung cancer cases^{13, 14}. Weber et al. applied the PLCO_{m2012} model to the Australian smokers cohort from the *45 and Up Study* and reported that it is applicable and generalizable to the Australian population¹³.

When applying the USPSTF or NLST criteria to our study cohort, 14 participants were identified as eligible for screening with LDCT. This is unsurprising given the inclusion criteria for screening in each are very similar except for eligible age range^{2, 12}. When comparing USPSTF

with PLCO_{m2012}, Manners et al. reported the USPSTF criteria lead to identification of more eligible participants than PLCO_{m2012} criteria¹⁵. We observed the USPSTF criteria identified fewer eligible high risk participants than PLCO_{m2012} criteria (6.1% vs. 10.0%, p=0.03). This finding is likely explained by several reasons. Our study population of people undergoing CTCA is considerably different to a cross-sectional study of the Busselton Shire of Western Australia and the age limit of that study was only 68 years.

Previous authors have suggested CTCA as a possible technique for opportunistic lung cancer screening based on a high number of incidental findings^{4, 5, 9, 16, 17}. La Grutta et al. found that 6886 incidental non-cardiac findings were detected in 4303 patients and only 865 (20.1%) of their patients did not have any incidental findings⁴. Cademartiri et al. also observed 1234 incidental non-cardiac findings in 670 patients and a similar proportion of patients without incidental findings (20.6%)¹⁶. The most common major finding in both studies was pulmonary nodule. However with only a limited field-of-view (FOV), CTCA is inferior to full-FOV imaging of the thorax for detecting lung nodules and neoplasms¹⁷. This is because lung cancer is most likely to occur in the upper zones¹⁸ and consequently some have advocated for including full-FOV at CTCA¹⁷. A recent paper has given information on the Australian population where full-FOV identified nodules in 358 patients of 2530 undergoing CTCA where, if limited-FOV were utilised, only 23 nodules (6%) would be identified¹⁹.

From our cohort of people undergoing CTCA, only 23 (10%) participants were eligible for lung cancer screening with LDCT using the PLCO_{m2012} risk calculator. Even though smoking is a

shared risk factor for coronary artery disease and lung cancer, the population often referred for CTCA demonstrate a low prevalence of CAD¹⁰. We have established this cohort also has a very low prevalence of patients at high risk for lung cancer. Therefore, routine application of full-FOV thoracic imaging during CTCA is not appropriate. Limited-FOV may be more appropriate as fewer pulmonary nodules are identified and there is a cost benefit compared to full-FOV¹⁹. Ninety-three (40.6%) people undergoing CTCA in our study were smokers or ex-smokers. Onuma et al.⁵ noted that 52% of their CTCA patients were current (65/503) or ex-smokers (197/503). This lower percentage of smokers in our CTCA patient cohort is likely explained by the trend of declining smoking consumption in Australia²⁰. Given a very small proportion of our population demonstrate high risk of lung cancer, the net risk of harm from routine full thoracic imaging during CTCA likely outweighs any benefit from opportunistic screening.

Targeted lung cancer screening of appropriately selected and counselled high risk individuals undergoing CTCA is yet to be considered. Studies addressing this gap in the literature are needed so that authorities can deliver the most efficient and effective screening program. If this is to be tenable in the future, health services will need to know their population undergoing CTCA. In our population, 21.4% were current smokers. It may be more appropriate to establish routine smoking cessation interventions to reduce lung cancer among this group than routine screening.

We recognize there are limitations to our study. Our sample size of 229 patients is limited however we believe it is representative of the targeted study population as all patients referred for CTCA were screened for inclusion, and we achieved a very high participation rate

among eligible patients. The study was carried out in two metropolitan tertiary hospitals and therefore may not be representative of other populations, for example rural Australia, where prevalence of ischaemic heart disease is known to be higher²¹.

Conclusion

In conclusion, 90% of people undergoing CTCA have insufficient lung cancer risk to be eligible for lung cancer screening. We suggest that routine screening of this group, in the form of full thoracic imaging, would result in net harm if opportunistic lung cancer screening were implemented at the time of CTCA. We therefore do not recommend opportunistic lung cancer screening is incorporated into CTCA protocols.

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Figure 1. Flow chart of patient eligibility

NESB = Non-English Speaking Background

	Site 1	Site 2	Total
Patients undergoing CTCA	92	137	229
Age breakdown of all patients			
<55	36	50	86
55-80	54	87	141
>80	2	0	2

Smoking Status of all patients				
	Smoker	26	23	49
	Ex-smoker	16	28	44
	Non-smoker	50	86	136
Breakdown of eligible participants				
	Mean Age (SD)	67.7 (6.8)	63.7 (4.9)	65.4 (6)
	Current Smokers	4	10	14
	Patients who stopped smoking within the last 15 years	4	5	9
	Patients who stopped smoking >15 years ago	13	14	27
	Patients with e30 pack year smoking history (current smokers)	11 (2)	13 (6)	24 (8)
	Patients with COPD	1	3	4
	History of cancer	4	2	6
	Family history of lung cancer	2	4	6

Table 1. Demographics of patients broken down according to age groups and smoking status.
SD = standard deviation

Abstract

Incidental findings, including pulmonary nodules, on Computed Tomography Coronary Angiography (CTCA) are common. Previous authors have suggested CTCA could allow opportunistic screening for lung cancer, though the lung cancer risk profile of this patient group has not previously been established. Smoking histories of 229 patients undergoing CTCA at two tertiary hospitals in Victoria during 2017 were reviewed, and their lung cancer risk calculated using validated risk prediction models. We found a very low proportion of patients undergoing CTCA were at high risk for lung cancer; only 59 (25%) were current or former smokers aged 55-80 years old, with less than half of this group eligible for lung cancer screening with LDCT chest based on the PLCO_{m2012} risk model. We conclude that routine screening in the form of full thoracic field imaging, of individuals undergoing CTCA is not appropriate as it would likely result in net harm.

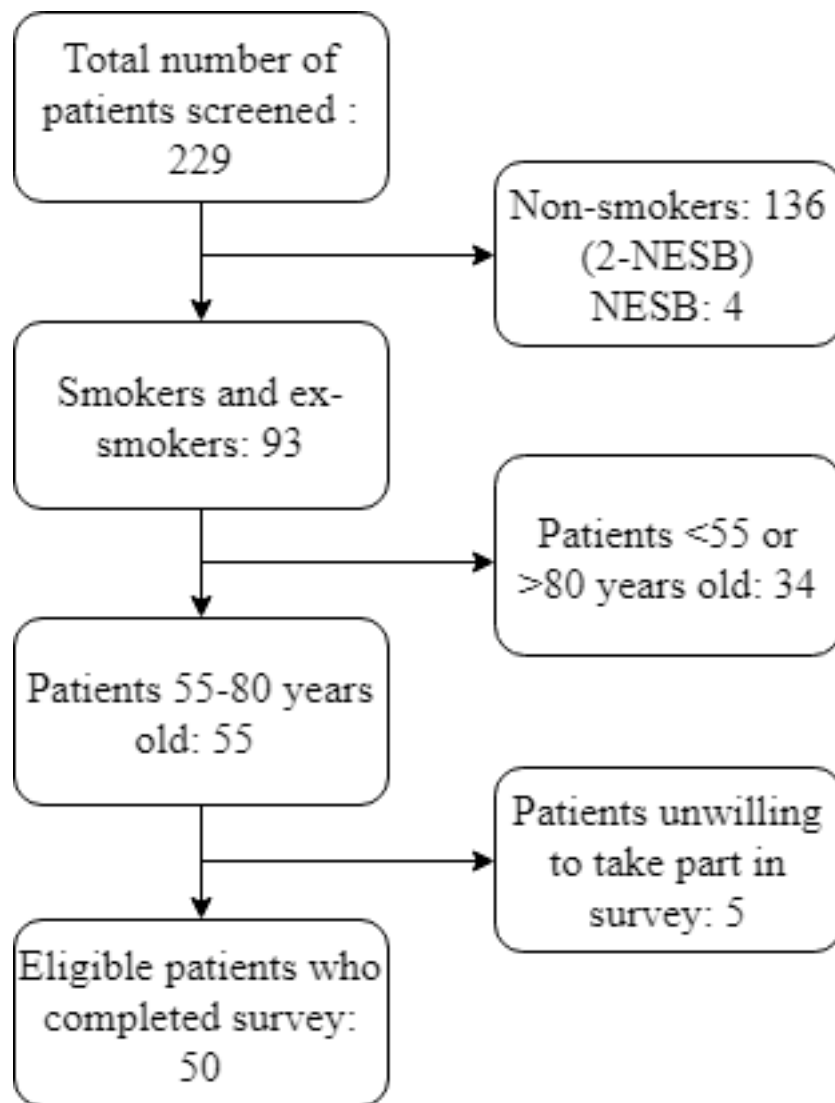


FIGURE-1.PNG

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