

Pre Transcatheter-Aortic Valve Replacement CT Scans: An Opportunity Missed to Detect Lung Cancer?

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Abstract

Background

This study aimed to investigate the incidental pulmonary nodule findings in Trans Catheter Aortic Valve Replacements (TAVR) patients undergoing preoperative computed tomography (CT) scan workup and occurrence of appropriate CT scan follow-up for nodule management in eligible patients.

Methods

A single-center TAVR data was retrospectively analyzed between 2011 and 2017 to identify the incidental pulmonary nodule finding on preop chest CT scans routinely performed as part of TAVR workup. The primary study objective was to determine incidence of pulmonary nodule and to investigate occurrence of appropriate diagnostic follow-up and cancer in patients eligible for follow-up CT scan based on Fleischner criteria.

Results

Of the 899 patients (mean age 79 years, 50% male), 220 patients had finding of pulmonary nodule (117 multiple and 103 solitary) and 93 were eligible for a follow-up CT scan based on the Fleischner criteria. Of the 93 follow-up eligible patients, 35 (38%) had repeat CT scan and 58 (62%) had no follow-up CT scan. The lung cancer occurrence in no CT scan, CT within timeframe, CT early and CT delayed groups was 1 each (2% v. 14% v. 7% v. 7%. p=0.3).

Conclusion

This single center report shows that the pre TAVR CT scans serve as an excellent lung cancer screening opportunity, however most patients (92%) do not have an appropriate follow-up CT scan for the diagnosis and management of the nodules. A larger observational study using the Medicare database may shed more light on real-world practice of pulmonary nodule diagnostic management in TAVR patients.

Keywords: nodule; ct scan; pulmonary; tavr

List of abbreviations

CT – Computerized Tomography

Introduction

In the United States over 70,000 transcatheter aortic valve replacement (TAVR) procedures are performed annually, primarily in patients aged over 65 years (93%) [1]. All patients undergoing the TAVR have a chest CT Angio (CTA) done prior to the procedure to determine aortic annulus size. Pulmonary nodule could be an incidental finding in these patients which may warrant further follow-up based on Fleischner criteria, however it is unclear how many of these eligible patients with pulmonary nodules receive follow-up management per guidelines [2]. We aimed to identify incidence of pulmonary nodules in patients receiving pre TAVR CTA and determine

CTA – Computerized Tomography Angiography

TAVR – Trans-Catheter Aortic Valve Replacement

appropriate subsequent diagnostic management and occurrence of cancer in these patients.

Methods

After IRB approval, a single-center TAVR data was retrospectively analyzed between 2011 and 2017 to identify the incidental pulmonary nodule finding on preop chest CTA routinely performed as part of TAVR workup. Other chronic lung disease conditions were also evaluated. We further evaluated patients with pulmonary nodule to ascertain if the eligible patients received appropriate follow-up CT scans to identify any changes in the pulmonary nodules and its applicable management

The primary study objective was to determine incidence of pulmonary nodule in cohort of patients undergoing TAVR and to identify occurrence of appropriate diagnostic follow-up and cancer in patients with presence of pulmonary nodules. Basic descriptive statistics were used to analyze the data. The cohort was divided in 4 groups based on occurrence of follow-up CT scan based on Fleischner criteria.

Results

During the study period, 899 patients (mean age 79 years, 50% male) underwent TAVR procedure and preop CTA. The occurrence of pulmonary nodule was in 220 (24%) of patients. Of all patients, 263 had pleural effusion

(186 bilateral, 37 left, 40 right), 154 had emphysema, 43 had pulmonary fibrosis, and 29 had interstitial lung disease.

Of the 220 pulmonary nodule patients, 117 had multiple (49 were 6mm and 19 not available) and 103 had solitary (48 were 8mm, 11 not available) nodules. Of the 49 patients with multiple nodules >6mm, 21 had follow-up CT performed, of which only 2 had between 90-180 days (recommended timeframe), 9 had prior to 90, and 10 had after 180 days. In the 16 patients with solitary nodule sized 6-8mm, 4 had repeat CTA, 2 within 6-12 months, (recommended timeframe) 1 prior, and 1 after the recommended timeframe. In the 28 patients with solitary nodule >8mm, 10 had repeat CT scans, 3 between 3-6months (recommended timeframe), 3 after 6months, and 4 prior to 3 months (Figure 1).

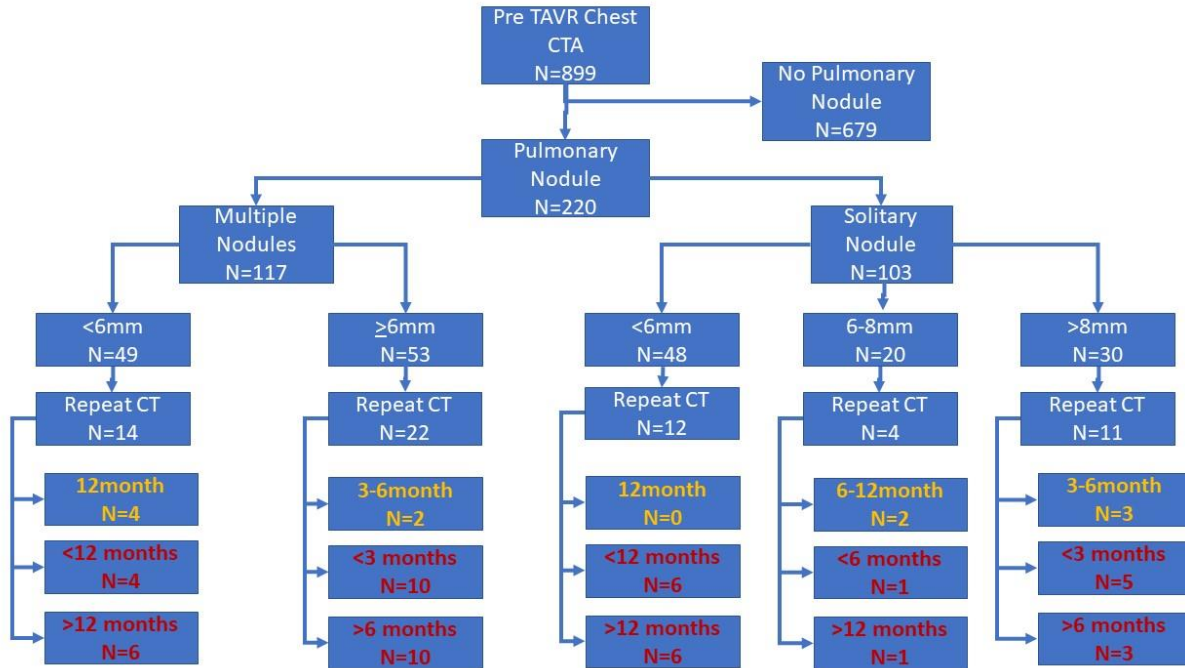


Figure 1: Pulmonary Nodule and Follow-up CT scan eligibility Post TAVR

Of the 220 pulmonary nodule patients, 93 were eligible for a repeat CT scan based on the Fleischner criteria (>6mm nodule size for solitary and multiple). Of the 93 follow-up eligible patients 35 had repeat CT scan (7 within the timeframe of Fleischner criteria, 14 before and 14 after the recommended timeframe, Figure 1). Patients who received timely follow-up CT scans were more likely to be smokers, older and less likely to be African Americans (Table 1).

	No CT Scan	CT in Time	CT early	CT delayed	p-value
Age	82 (77-84)	85 (73-87)	79 (73-84)	79 (68-84)	0.4
Sex (1)	50% (29)	43% (7)	31% (4)	43% (6)	0.6
Race (AA)	5% (3)	0 (0)	15% (2)	7% (1)	0.5
Smoker	7% (4)	33% (2)	23% (3)	7% (1)	0.1
Hypertension	95% (56)	86% (6)	100% (13)	86% (12)	0.2
Diabetes	47% (27)	29% (2)	15% (2)	29% (4)	0.1
Dialysis	2% (1)	0 (0)	8% (1)	14% (2)	0.1
Home O2	2% (1)	0 (0)	15% (2)	7% (1)	0.1
Immunosuppression	17% (10)	29% (2)	31% (4)	14% (2)	0.6
Surgical Risk Score	9 (6-12)	8 (4-9)	10 (8-16)	10 (8-11)	0.2

Table 1: Differences in Patient Characteristics by Status of Follow-up CT scan

The lung cancer occurrence in no CT scan, CT within timeframe, CT early and CT delayed groups was 1 each (2% v. 14% v. 7% v. 7%. p=0.3). The

occurrence of lung cancer in patients who had any follow-up CT scan was 9% vs. 2% in patients who had no follow-up CT scan (p=0.11). Twelve

patients in the nodule size <6mm group had lung cancer, of which 8 were diagnosed prior to TAVR and 4 after the procedure.

Discussion

The incidence of pulmonary nodule in our single center cohort of patients undergoing TAVR was 24%, similar to the number (27%) reported on the low dose CT scan trial [3]. In patients with a nodule >6mm, we observed that over 92% patient did not have an appropriate follow-up CT scan. Of all eligible patients (n=93), only 37% (35) received a follow-up CT scan and only 8% (7) within the recommended timeframe. Whereas 62% patients had no CT scan, and the rest had prior (15%) to or later (15%) than the recommended timeframe. Of 93 CT scan eligible patients 4% (4) had diagnosis of lung cancer which is slightly higher (1.1%) than reported on low-dose CT trial [3]. Although patients with follow-up CT scan within appropriate timeframe had higher detection rate (14% vs. 2% v. 7% v. 7%) of lung cancer, it did not reach statistical significance.

Our observations highlight lack of recommended follow-up CT scans in patients with pulmonary nodules. However, several factors could be responsible for these findings, including advanced age (median age 79 years), presence of comorbidities (35% diabetics, >85% hypertensives, >25% immunosuppressed), disabilities and inadequate family support. This study also suggests the racial disparity in receipt of follow up scan where no African American patients received a CT scan in appropriate follow-up timeframe [4]. Our findings corroborate other reports published using single center data on prevalence of incidental pulmonary nodules in pre-TAVR CTA, however, no other studies have focused on occurrences of follow up diagnostic management of the nodules based on widely accepted Fleischner criteria [4-6]. With approval of TAVR in low-risk patients, younger patients are likely to receive TAVR and the preop CTA, thus, increasing the pool of patients on whom an indirect screening for lung cancer can be done in addition to the aortic stenosis evaluation.

Being a retrospective single center study, several limitations apply. A major limitation is lack of individual scenarios responsible for no follow-up CTA in over 60% patients. Also, patients receiving follow-up elsewhere could not be accounted for.

Conclusion

This single center report shows that the pre TAVR CTA serve as an excellent lung cancer screening opportunity, however most patients (92%) do not have an appropriate follow-up CT scan for the diagnosis and management of the nodules. This study may prompt more institutionalized and protocol-based approach for improving follow-up nodule workup. A larger study using the Medicare database may shed more light on real-world practice of pulmonary nodule diagnostic management in TAVR patients.

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