

## **Teleradiology Cohort of Pre-TAVI CT: Frequency and Types of Extracardiac Incidental Findings**

Amr Ajlan<sup>1</sup>



<sup>1</sup>Department of Radiology, King Abdul Aziz University Hospital

**Abstract— Objectives:** This study aimed to assess the prevalence and nature of extracardiac incidental findings in patients undergoing computed tomography (CT) scans before transcatheter aortic valve implantation (TAVI). **Materials and Methods:** This retrospective cohort teleradiology study analyzed 33 patients' pre-TAVI CT scans. The study identified and categorized incidental extracardiac findings, highlighting significant findings and those of clear or potential malignancy. **Results:** All participants in the study had at least one incidental extracardiac finding, with a total of 115 occurrences of 43 different types being recorded. The most common findings were spinal degenerative disc disease, renal cysts, pulmonary edema, and pleural effusions. 73% of the cohort were identified as having clinically significant extracardiac findings. In terms of clearly or potentially malignant findings, these were observed in 42% of the cohort, including renal cell carcinoma, large paratracheal soft tissue mass, multinodular thyroid gland, lung nodules, and prostate enlargement. **Conclusion:** This study highlights the significant occurrence of extracardiac incidental findings, many of which are clearly or potentially malignant, in pre-TAVI CT scans. These findings underscore the necessity for thorough pre-procedural evaluations in TAVI candidates, as they can influence patient management and outcomes. Future research should aim for larger, multicenter, prospective studies to understand better and validate the long-term implications of these incidental findings.

**Keywords:** Transcatheter aortic valve implantation, TAVI, Aortic valve, Cardiac imaging, Computed tomography

### **INTRODUCTION:**

Transcatheter aortic valve implantation (TAVI), also known as transcatheter aortic valve replacement (TAVR), has established itself as a proven treatment for severe symptomatic aortic stenosis. Its application has expanded from high-risk surgical patients to those with bicuspid aortic valve stenosis and low-risk patient populations [1–5]. Additionally, recent literature has demonstrated that TAVI offers better outcomes than surgical options, even for low-risk patient groups [1]. This expansion of TAVI's use represents a significant evolution in managing aortic stenosis, providing a minimally invasive alternative for a broader spectrum of patients.

Computed tomography (CT) imaging plays a crucial role in TAVI procedures. Advances in CT imaging are integral for assessing anatomical suitability, planning the procedure, and post-

procedural evaluation in TAVI [6]. With technological advancements, CT imaging has become deeply integrated with TAVI, aiding in precise measurements and improving procedural outcomes. This integration is underscored in recent expert consensus documents and clinical studies, which emphasize the indispensable role of CT in TAVI, from pre-procedure planning to post-procedure monitoring and follow-up [6].

In light of the advanced age and comorbid conditions typically associated with patients undergoing CT assessment before TAVI, the detection of extracardiac incidental findings is frequently reported in this demographic [7,8].

Our study aimed to evaluate the prevalence and nature of such findings within a case collection conducted in a Saudi teleradiology practice. The focus was on categorizing these findings into clinically significant and potentially malignant categories, providing insights that could benefit patient management in this specific patient group.

## **MATERIALS AND METHODS:**

### **Subjects:**

This retrospective cohort study was conducted by querying the term "TAVI" within radiology reports from the Picture Archiving and Communication System (PACS; PaxeraUltima, version 6.0.2.6, PaxeraHealth, Newton, MA, USA). The study period ranged from November 23, 2019, to September 14, 2023. An initial pool of 34 cases was identified, from which 33 patients were included in the final analysis after excluding one case because it was performed for post-TAVI assessment. The need for individual patient consent was waived, and Institutional Review Board approval was obtained for the study.

### **Image Analysis:**

The patient cohort was assessed for age and gender. The original CT examinations were conducted using standardized protocols on various multidetector CT scanners. The initial reading and interpretation of the radiological reports were undertaken by a team of three experienced radiologists, collectively with 5 to 22 years of experience in diagnostic imaging interpretation. During the analysis, extracardiac findings were recorded. These findings were then categorized by their occurrences and types. A subjective assessment was employed to determine the significance of each finding. Significant findings were identified as clearly or potentially malignant, potentially denoting a negative prognosis, commonly presenting with symptoms, requiring treatment, or needing further imaging. Special attention was given to findings that were malignant or potentially malignant.

### **Statistical Analysis:**

Data collection was performed using Microsoft Excel 2021, the latest version available at the time of this study, known for its advanced data management capabilities. The statistical analysis

was facilitated by ChatGPT, an advanced language model artificial intelligence (version 4) developed by OpenAI, based in San Francisco, United States. This AI tool computed the collected data's absolute, mean, and standard deviations (SD) values. To ensure the validity and reliability of the computational analysis, all results were independently verified by a human researcher, offering a robust layer of verification to the study's statistical approach.

**RESULTS:**

22 males accounted for 67% of the 33 patients cohort. The average age of the participants was 73 years, with a standard deviation of 8 years.

The entire study group had one or more incidental findings. We identified a total of 115 occurrences of extracardiac findings, covering 43 different types. Table 1 details all of the detected findings with their occurrences. Spinal degenerative disc disease was the most prevalent, found in 14 cases (42%), followed by renal cysts in 11 patients (33%). Pulmonary edema and pleural effusions were also noted in 10 (30%) and 9 (27%) patients, respectively. Lung nodules and emphysema were present in 6 (18%) and 5 (15%) cases, respectively.

24 out of the 33 cases in the study, representing approximately 73% of the cohort, were identified as having clinically significant extracardiac findings. Conversely, 9 cases, constituting around 27% of the cohort, were classified as having clinically insignificant extracardiac findings. The study focused particular attention on findings that are clearly or potentially malignant. This subset included one case of renal cell carcinoma (3 %), one case of a large paratracheal soft tissue mass (3%), two cases of a multinodular thyroid gland (6%), four cases of lung nodules measuring 6 mm or more in diameter (12%), and four cases of prostate enlargement (12%). Together, such findings constituted 42% of our study cohort.

<b>Finding</b>	<b>Occurrences</b>	<b>Percentage of Total Patients (%)</b>
Degenrativesoinal changes	14	42
Renal Cyst	11	33
Pulmonary Edema	10	30
Pleural Effusions	9	27
Lung Soft Tissue Nodule	6	18
Emphysema	5	15
Small Airways Disease	4	12
Prostate Enlargement	4	12
Diverticulosis	3	9
Hiatus Hernia	3	9
Renal Atrophy	3	9

<b>Finding</b>	<b>Occurrences</b>	<b>Percentage of Total Patients (%)</b>
Inguinal Hernia	3	9
Adrenal Adenomas	2	6
Obstructive Urinary bladder Mural Thickening	2	6
Umbilical Hernia	2	6
Gallstone	2	6
Lung Calcific Granuloma	2	6
Multinodular Thyroid Gland	2	6
Prostate Enlargement	2	6
Pancreatic Cyst	2	6
Age-Related Minimal lung reticulations	2	6
Chronic Portal Vein Occlusion	1	3
Focal Bronchiectasis	1	3
Pleural Effusion	1	3
Ascites	1	3
Pneumatocoele	1	3
Pubic Ramus Old Fracture	1	3
Sacroiliitis	1	3
Uterine Fibroid	1	3
Adrenal Adeoma	1	3
Apical Pleuroparenchymal Scarring	1	3
Liver Irregularity	1	3
Thyroid Gland Cyst	1	3
Hepatic Calcific Granuloma	1	3
Abdominal Lymphadenopathy	1	3
Right Renal Carcinoma	1	3
Vertebral Body Wedging	1	3
Calcific Mediastinal Lymph Node	1	3
Pars Interarticularis Defects	1	3
Shoulder Degenerative Changes	1	3
Epigastric Hernia	1	3

<b>Finding</b>	<b>Occurrences</b>	<b>Percentage of Total Patients (%)</b>
Postsurgical Pneumobelia	1	3
Paratracheal Soft Tissue Mass	1	3

**Table 1. A list of types, occurrences, and percentages of incidental findings detected on pre-TAVI CT examinations.**

### **DISCUSSION:**

This research focused on examining the frequency and characteristics of extracardiac incidental findings in patients receiving CT scans before undergoing TAVI. The observation that every participant in our study had at least one incidental finding highlights the critical need for thorough evaluations before the procedure. The notable prevalence of these findings in our cohort, which typically includes older individuals, aligns with trends and observations previously documented in the medical literature[8–11]. Another concordance with the literature is that the lung was the most commonly involved organ in this population [8,9].

Significant incidental extracardiac findings in pre-TAVI CT studies have been reported with wide variability, ranging from as low as 7% to as high as 38%[1,7–15]. Our study observed a notably higher incidence of these findings, amounting to 73%. Furthermore, we identified an incidence rate of 42% for extracardiac findings that are either clearly or potentially malignant. This contrasts the existing literature, which typically reports such findings from 1 to 7%[1,8,11,12]. It is important to mention that our analysis included indeterminate thyroid nodules and prostate enlargement as conditions with potential for malignancy. However, if these two entities are excluded, the incidence of findings with possible malignancy decreases to 18%. Nevertheless, the finding echoes the growing body of evidence stressing the need for vigilance for extracardiac conditions in TAVI candidates, which may impact patient outcomes and management strategies.

The study's retrospective design is a notable limitation, as it may introduce selection bias and limit the ability to establish causality between the observed findings and patient outcomes. Additionally, the relatively small size of the cohort poses a constraint on the generalizability of the findings to a broader population. Another aspect to consider is the inclusion of indeterminate findings such as thyroid nodules and prostate enlargement in the analysis, which could potentially inflate the incidence of findings classified as potentially malignant. Furthermore, this study's lack of long-term follow-up means that the long-term outcomes or clinical significance of these incidental findings remain unclear. Lastly, being a single-center study, the findings may predominantly reflect the specific practices or patient demographics of the center and may not be directly applicable to other settings or populations.

In conclusion, this study highlights the significant occurrence of extracardiac incidental findings in pre-TAVI CT scans, with a notable proportion being potentially malignant. This emphasizes the importance of thorough pre-procedural evaluations for TAVI candidates, as these findings may influence patient management and outcomes. Future research should focus on expanding these findings through larger, multicenter, prospective studies to enhance their applicability and understanding of the long-term implications of these incidental findings.

**MANUSCRIPT TYPE:**

Original research

**ABBREVIATIONS:**

Transcatheter Aortic Valve Implantation (TAVI) = TAVI, Transcatheter Aortic Valve Replacement = TAVR, Computed Tomography = CT, Standard Deviation = SD

**ACKNOWLEDGEMENT:**

None.

**COMPETING INTERESTS:**

The author has declared that no direct competing interests exist; however, the author is a part-time consultant for the Diagnostics Elite Teleradiology Company of Jeddah, Saudi Arabia.

**AUTHORS' CONTRIBUTIONS:**

The author contributed to the study design, statistical analysis, protocol formation, manuscript writing, and final proofreading.

**CONSENT FORM:**

The consent form was waived.

**ETHICAL APPROVAL:**

The Diagnostics Elite Teleradiology Company Ethical Committee Board approved the study.

**REFERENCES:**

- [1] Forrest JK, Deeb GM, Yakubov SJ, et al.: 3-Year Outcomes After Transcatheter or Surgical Aortic Valve Replacement in Low-Risk Patients With Aortic Stenosis. *J Am Coll Cardiol.* 2023, 81:1663–74. 10.1016/j.jacc.2023.02.017
- [2] Dayawansa NH, Noaman S, Teng LE, Htun NM: Transcatheter Aortic Valve Therapy for Bicuspid Aortic Valve Stenosis. *J Cardiovasc Dev Dis.* 2023, 10:421. 10.3390/jcdd10100421
- [3] Chiochi M, Ricci F, Pasqualetto M, et al.: Role of computed tomography in transcatheter aortic valve implantation and valve-in-valve implantation: complete review of preprocedural and postprocedural imaging. *J Cardiovasc Med.* 2020, 21:182–91. 10.2459/jcm.0000000000000899
- [4] Costa G, Angelillis M, Petronio AS: Bicuspid Valve Sizing for Transcatheter Aortic Valve Implantation: The Missing Link. *Front Cardiovasc Med.* 2022, 8:770924. 10.3389/fcvm.2021.770924
- [5] Dalby M: State of the art in TAVI. *Eur Hear J.* 2018, 39:1878–81. 10.1093/eurheartj/ehy213
- [6] Blanke P, Weir-McCall JR, Achenbach S, et al.: Computed Tomography Imaging in the Context of Transcatheter Aortic Valve Implantation (TAVI)/Transcatheter Aortic Valve Replacement (TAVR) An Expert Consensus Document of the Society of Cardiovascular Computed Tomography. *JACC: Cardiovasc Imaging.* 2019, 12:1–24. 10.1016/j.jcmg.2018.12.003
- [7] Macmillan MT, Williams MC: Incidental Non-cardiac Findings in Cardiovascular Imaging. *Curr Treat Options Cardiovasc Med.* 2018, 20:93. 10.1007/s11936-018-0700-5
- [8] Ko K, Zwetsloot P-P, Voskuil M, Stella P, Leiner T, Kraaijeveld A: Clinically Significant Incidental Findings on CT Imaging During TAVI Work-up: A Systematic Review and Meta-Analysis. *J Invasive Cardiol.* 2022, 34:E218–25.
- [9] Markowiak T, Holzamer A, Hilker M, Pregler B, Debl K, Hofmann H-S, Ried M: Incidental thoracic findings in computed tomography scans before transcatheter aortic valve implantation. *Interact Cardiovasc Thorac Surg.* 2018, 28:559–65. 10.1093/icvts/ivy299
- [10] Stachon P, Kaier K, Milde S, et al.: Two-year survival of patients screened for transcatheter aortic valve replacement with potentially malignant incidental findings in initial body computed tomography. *Eur Hear J - Cardiovasc Imaging.* 2015, 16:731–7. 10.1093/ehjci/jev055
- [11] Kesteren F van, Wiegerinck EMA, Mourik MS van, et al.: Impact of Potentially Malignant Incidental Findings by Computed Tomographic Angiography on Long-Term Survival After Transcatheter Aortic Valve Implantation. *Am J Cardiol.* 2017, 120:994–1001. 10.1016/j.amjcard.2017.06.032

- [12] Demirel C, Tomii D, Heg D, et al.: Incidental detection of malignancy during preprocedural workup for transcatheter aortic valve implantation: A longitudinal cohort study. *Am Hear J.* 2023, 261:51–4. 10.1016/j.ahj.2023.03.011
- [13] Patel A, Mahendran K, Collins M, Abdelaziz M, Khogali S, Luckraz H: Incidental abnormal CT scan findings during transcatheter aortic valve implantation assessment: incidence and implications. *Open Hear.* 2018, 5:e000855. 10.1136/openhrt-2018-000855
- [14] Trenkwalder T, Lahmann AL, Nowicka M, et al.: Incidental findings in multislice computed tomography prior to transcatheter aortic valve implantation: frequency, clinical relevance and outcome. *Int J Cardiovasc Imaging.* 2018, 34:985–92. 10.1007/s10554-018-1305-5
- [15] Showkathali R, Sen A, Brickham B, Dworakowski R, Wendler O, MacCarthy P: “Incidental findings” during TAVI work-up: more than just an inconvenience. *EuroIntervention.* 2015, 11:465–9. 10.4244/ejy14m06\_04



This work is licensed under a Creative Commons Attribution Non-Commercial 4.0 International License.