IJBPAS, June, Special Issue, 2023, 12(6): 01-13

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

RETROSPECTIVE RANDOMIZED ASSESSMENT OF APPROPRIATENESS OF CORONARY COMPUTED TOMOGRAPHY AT SUR HOSPITAL IN OMAN

TARIQ AL SAADI[1*] DIAA YOUSSIF[1], ENAAM ALALAWI[1], MOHAMMED KDHIR[1], SHAIMA AL RUZAIQI[1], TEJAUS M. KOLHAR[2], HAVAGIRAY R. CHITME[2]

1: Sur Hospital, Ministry of Health, Sultanate of Oman

2: Faculty of Pharmacy, DIT University, Dehradun, Uttarakhand – 248009, India

***Corresponding Author: E Mail: Mr. Tariq Al Saadi: tariqalsaadi80@gmail.com**

Received 19th Jan. 2023; Revised 20th Feb. 2023; Accepted 3rd March 2023; Available online 15th June 2023

https://doi.org/10.31032/IJBPAS/2023/12.6.1006

ABSTRACT

Objective: To analyze the appropriateness of Coronary computed tomography angiography (CCTA) referrals by cardiologists in selected tertiary care hospital of Oman.

Methods: In this study 220 patient's records were randomly selected for retrospective study of records of all eligible cases referred for coronary computed tomography angiography at Sur Hospital in Oman from May 1st, 2013 to December 31st, 2016.

Results: In total 220 patients screened out of which 175 were included in the study. The majority of CCTA referrals were made for "Detection of Coronary Artery Disease (CAD)" in suspected ischemia equivalent in 50.9% (n=89). The population's average age was 57.3 years, and 61.1% of the population (n=107) were male. Followed by detection of CAD in asymptomatic patients 21.1% (n=37). There were no patients referred to CCTA for the indication of "Evaluation of cardiac structure and function". It was found that 40% (n=70) of our Cardiologists referrals for CCTA were within the "uncertain" category, while 36.6% (n=64) were in the "appropriate" and 23.4% (n=41) were in the "inappropriate" category.

Conclusions: This study demonstrates a relatively inappropriate use of CCTA at Sur Hospital in Oman. Installing a written protocol for CCTA referrals with line of the current guidelines is recommended to improve quality and avoid the inappropriate requests and abuse of the

CCTA modality. We recommend that there is a requirement of a local policy for these situations until there is agreement on the "uncertain" signals in the guidelines, which is necessary to expand our understanding of the appropriateness of CCTA referrals.

Keywords: Patient Referrals, Coronary computed tomography angiography, Coronary artery disease, Sur Hospital, Oman, American College of Cardiology Foundation

INTRODUCTION

According to the recent studies it is estimated that about 38 million citizens loose their life every year due to non-communicable diseases (NCDs). Especially due to cardiovascular disease (CVD), diabetes, respiratory diseases and the cancer. Out of which 17.5 million mortality is due to CVDs predominantly heart attack and stroke **[1, 2]**. Unhealthy lifestyle, aging, rapid unplanned urbanization are the risk factors for these disease. It is also proposed that globalization has led to unhealthy way of life leading to increased blood glucose level, rise in blood pressure, obesity and the elevated blood lipids **[3]**. In Oman, approximately 65-70% of total death is caused by NCDs. Out of these deaths, 33% are due to CVDs. Raise in blood pressure of adults is seen in 25% of population while, 21% of the population have obesity **[4]**. According to the studies hypertension associated cardiac diseases are the most important and cause for the worry as almost 71% of them lead to ischaemic heart disease. Rate of acute coronary syndrome among Omanis is highest with basic incidence rate of 338 per 100,000 person-year. Congenital heart disease affects the regular functioning of the heart, with an incidence of 7 per 1000 birth in Oman **[5]**.

Coronary atherosclerosis involves extended asymptomatic progression phases, which frequently result in nonfatal myocardial infarction (MI) or sudden cardiac death. Structural heart abnormality includes cardiomyopathy and congenital heart disease which may effect in symptoms like heart failure, fatigue, dyspnea, which reduces the superiority of living **[6]**. The 64-slice cardiac computed tomography angiography (CCTA), a non-invasive and potent image modalities emerging technology for the patient today, is acknowledged as a first-line test for the diagnosis of coronary artery and cardiac structural and functional evaluation **[7]**. The advancement of computed tomography (CT) technology, mostly due to improvements in volume coverage, temporal resolution, and spatial resolution, has made it possible to clearly evaluate coronary arteries and the structure of the heart on a regular basis **[8]**. This technology CCTA, has emerged as a result and has been quickly used in clinics to

examine individuals who may have coronary artery disease (CAD). By using fractional flow computed tomography (FFR_{CT}), it is possible to determine the degree of epicardial coronary thinning and its physiological effects **[9]**.

A relatively high radiation dose that was high prior to the CCTA examination's limiting factor has been significantly decreased in patients, going from 15-20 mSv to less than 1-2 mSv. CTA has been demonstrated to have equivalent diagnostic accuracy to invasive coronary angiography for the diagnosis of CAD; the calculation of CCAT has been shown to be more accurate than the SYNTAX score in comparison **[]10**. People who are suspected of having CAD can benefit from CCAT because it not only allows for a precise assessment of the coronary arteries but also offers vital details on other cardinal structures **[11]**. However, the rate of CCTA has demonstrated in evaluating a number of medical circumstances, and there have been growing worries about its excessive use in clinical settings, which is linked to the potential to expose patients to unwanted radiation in addition to placing a significant financial burden on health services. Therefore, the American College of Cardiology Foundation (ACCF) conducted a proper use analysis of a common clinical scenario where CCTA is frequently considered, along with important specialty and subspecialty associations. Nevertheless, patients who were referred for coronary CT angiography in underdeveloping and/or developing nation still differed significantly from the ACCF appropriateness criteria **[12]**.

Since May 2013, CCTA services have been available at Sur Hospital. The purpose of this retrospective study was to evaluate the appropriateness of referrals for coronary computed tomography angiography made by cardiologists in the current clinical settings at Sur Hospital in Oman because the appropriateness of CCTA referrals has not previously been addressed.

METHODS

Study design and patients

Out of 220 patients randomly selected, 175 were selected by simple randomization table from the database available in the hospital. These patients were referred for 64-slice CCTA at Sur Hospital in Oman, in time period from May 1st 2013 to December 31st 2016.

Data collection and analysis

Patient data was recruited through data collection form by cardiologists and radiologists as a part of their daily work from patient medical records called ALSHIFA 3+ SYSTEM which is applied by Ministry of Health institutions of Oman. These data were entered into an Excel spread sheet. Data collection form was designed to retrieve all information related

to demographic data, clinical characteristics, and symptoms and determine appropriateness level. Additional details were also retrieved along with the family history, prior to acute coronary syndrome, reason for recommendation to CCTA, and coronary artery disease (CAD) risk score such as Pre-test Probability for Symptomatic patients and Framingham risk criteria for asymptomatic coronary heart disease patients.

Assessment of Appropriateness:

Once the information extracted from ALSHIFA 3+ SYSTEM, every case was dedicatedly evaluated according to the guideline to evaluate appropriateness. All grading systems and definitions that were suggested or cited in the guideline were applied to ensure that the results were applicable. The suitability of the study was judged according to the ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2010 APPROPRIATE USE SCORE CRITERIA for CCTA **[13]**.

The indications were coded with their corresponding appropriateness level. The rating panel uses a scale of 1 to 9 to determine if an imaging method is appropriate for a certain indication or situation. There are three different ways to describe something being acceptable: appropriate (7-9), uncertain (4-6), and inappropriate (1–3) **[13]**. Cases that couldn't be determined from recommendations based on the CT scan and/or patient data were excluded.

Statistical analysis

The Kolmogorov-Smirnov test and a histogram were used to determine whether the data obtained using the data collecting form had a normal distribution. While categorical data are represented as frequency (%), continuous variables are represented as mean ± SD. The Chi-square test was used to compare categorical variables. One-way ANOVA was used to assess continuous variables and normally distributed data. Statistical significance was defined as a two-tailed $P < 0.05$. Variables were analysed using SPSS version 23.0 (IBM Corp., Chicago, Illinois, USA).

RESULTS

Study group characteristics

Of the 220 patients screened, 175 met the inclusion criteria. The reasons for exclusion was insufficient data in the patient's medical record to yield an appropriate score from the guideline (n=28), duplicate data entry of same patients (n=4) and cancellation of the procedure by the radiologists (n=13) due to high calcium score (n=6), renal impairment (n=3) and, lack of ability of the patients to hold their breath (n=4). **Table 1** lists the clinical traits of the 175 individuals that were a part of the study. The study population's median age was 57.3 years, and 61.1% of the patient records (n=107) belonged to males.

Reasons for referral

The main common reason for CCTA referrals was "detection of Coronary Artery Disease (CAD)" in suspected ischemic equivalent in 50.9% (n=89). The least common reason for CCTA requests was "in the setting of prior test results" in 2.9% (n=5). Other reasons for referral were "detection of CAD/Risk assessment in asymptomatic individuals without known CAD" in 21.1% (n=37), "detection of CAD with suspicion of Acute Coronary Syndrome (ACS)" in 10.9% (n=19), "risk assessment post revascularization" in 9.7% (n=17), and "detection of CAD in other clinical scenarios" in 4.6% (n=8). Interestingly, no patients were referred to CCTA for the indication of "evaluation of cardiac structure and function" **(Table 2)**.

Appropriateness of referrals

Figure 1 shows the proportion of referrals that have fall into every category of appropriateness according to "ACCF *et al*." criteria. 28% of the referrals were within the "uncertain" category, while 44% were in the "appropriate" category and 28% were in the "inappropriate" category.

Uncertain CCTA referrals were the most abundant category representing 28% of referrals (n =70), the most common indication was "detection of Coronary Artery Disease (CAD) in symptomatic patients either with acute or non-acute symptoms" representing 65.7% (n=46).

Appropriate CCTA referrals represent 44% (n = 64) and the most common sign was again "detection of Coronary Artery Disease (CAD) in symptomatic patients either with acute or non-acute symptoms" representing 81.25% (n=52).

Inappropriate CCTA referrals represent 28% (n = 41) were predominantly requested to detect CAD or for risk assessment in asymptomatic individuals without known CAD representing 43.9% (n=18). Followed by "detection of Coronary Artery Disease (CAD) in symptomatic patients either with acute or non-acute symptoms" category representing 24.4% (n=10) and Risk Assessment Post revascularization (PCI or CABG)"category representing 24.4% (n=10). No documented inappropriate CCTA referrals under the "detection of CAD in other clinical scenarios" category.

Clinical Characteristics of referrals

Table 3 illustrates the difference in clinical characteristic of records according to the "ACCF *et al*." criteria. The only statistically significant difference was between ages and the appropriateness level (P-value = 0.03).

Table 1: Clinical characteristics of the study population

Characteristics	Values	Percentage
Age in years	57.3 ± 12.4	-
Male	107	61.1
Smoking (Current)	15	8.6
Previous diagnosis of CAD	40	22.9
Diabetes	77	44
Hypertension	124	70.9
Hyperlipidemia	128	73.1
Symptomatic	133	76
Pre-test probability of CAD in symptomatic patients (n=133)		
Low	27	20.3
Intermediate	56	42.1
High	50	37.6
Framingham risk criteria in asymptomatic patients (n = 42)		
Low	13	31
Moderate	15	35.7
High	14	33.3

CAD: Coronary artery disease

Table 2: Reasons for CCT according to appropriate use criteria category

Appropriateness Level	CAD Detection in Symptomatic Patients with Non-acute Symptoms (Ischemic Equivalent)	CAD Detection in Symptomatic Patients with Acute Symptoms With Suspicion of ACS	CAD Detection in Asymptomatic Individuals	CAD Detection in Other Clinical Scenarios	In the Setting of previous Test Results	Risk Assessment Post revascularization (PCI or CABG)	Evaluation of Cardiac Structure and Function
Appropriate (n=64)	44	8	6	2	1	3	0
Uncertain (n=70)	42	4	13	6	1	4	0
Inappropriate (n=41)	3	7	18	0	3	10	0

CAD: coronary artery disease, ACS: acute coronary syndrome

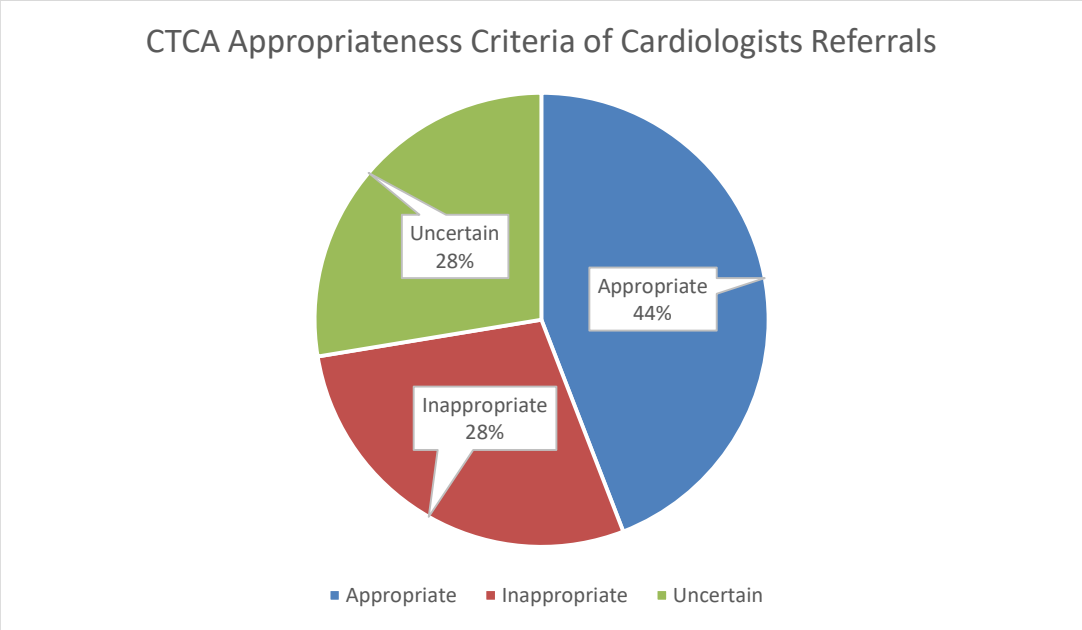

Figure 1: CTCA Appropriateness Criteria of Cardiologists Referrals

Table 3: Comparison of clinical characteristics by type of appropriate use criterion

Characteristics	Appropriate	Uncertain	Inappropriate	P-Value
Age in year	54.5	61.1	54.9	0.03
Male (%)	35	48	24	0.239
Smoking (current)	9	4	2	0.128
Previous diagnosis of CAD	12	16	12	0.457
Diabetes	26	33	18	0.750
Hypertension	44	50	30	0.880
Dyslipidemia	48	52	28	0.723
Symptomatic	52	54	27	0.189

DISCUSSION

The current study is the first of its type in Oman to evaluate and document whether CCTA referrals are appropriate in accordance with ACCF2010 score criteria for CCTA guideline **[13]**. In this study, we reviewed the CCTA referrals over 3 years at Sur hospital in Oman. The CCTA service started in Sur Hospital in may/2013; therefore, this study has been done to improve the quality of CCTA referrals by evaluating the appropriateness of the CCTA referrals from the onset of the CCTA service and for 3 years. Both cardiology and radiology department co-operated in this study.

Generally, the results indicate improper utilization of CCTA modality when reviewed according to the published guidelines. The results reveal a relatively high proportion of uncertain use, low proportion of appropriate use and relatively high proportion of inappropriate use when comparing with studies using the same guidelines **[14-17]**.

Interestingly, the results reflected that a high percentage of referrals were categorized "uncertain" by guidelines which resemble the results in similar studies **[12, 13, 18-20]**. Nevertheless, the proportion of "uncertain" category in our study was doubled higher than these studies. In view of that, implementation of a local hospital protocol is mandated till reaching a consensus on the guidelines in such cases.

Commonly the reason for CCTA referrals was "detection of Coronary Artery Disease (CAD) in symptomatic patients either with acute or non-acute symptoms" in 61.7% of the referrals (n=108) [**21**]. The second reason was "detection of CAD/risk assessment in asymptomatic individuals without known CAD" in 21.1% of the referrals (n=37). The third reason was "risk assessment post revascularization" in 9.7% of the referrals (n=17). The fourth reason was "detection of CAD in other clinical scenarios" in 4.6% of the referrals (n=8). The least common reason for CCTA requests was "in the setting of prior test results" in 2.9% of the referrals (n=5). Interestingly, no patients were referred to

CCTA for the indication of "evaluation of cardiac structure and function" **[22, 23]**.

The "inappropriate" category revealed a relatively high proportion of referrals to those reported in similar studies; however, this study showed similar result regarding the most common indication of inappropriate referrals which is "detection of CAD /risk assessment in asymptomatic individuals without known CAD" **[11, 14. 16, 17]**. It is worth mentioning that we evaluated these referral against the 2010 "ACCF *et al*." guidelines which was the applied guidelines during the analyzed period; however, the updated "ACCF *et al*." guidelines in 2017 changed the indications for asymptomatic individuals and all of these inappropriate requests due to this reason, if got re-evaluated now, will be either appropriate or uncertain **[24]**.

The study affirms that most of the patients referred to CCTA were symptomatic. As a result, individuals are more likely to gain from CCTA's high-negative predictive value, which offers a reliable means of excluding CAD and avoiding the risk of invasive angiography. Therefore, it is not unexpected that both this study and other similar investigations recognised the discovery of CAD in symptomatic patients as the most prevalent eligible indication for referral to CCTA **[16, 17]**.

Study limitations

This study was done by reviewing the clinical data that was documented by the requesting doctors in the medical records of the patients. Any inaccurate data may have resulted in inaccurate categorization. We didn't take into consideration the benefit/risk ratio related to the use of CCTA due to radiation and the possible contrast-induced nephropathy

CONCLUSION

This study demonstrates a relatively inappropriate use of CCTA at Sur Hospital/Oman, establishing a great room for improvement. Installing a written protocol for CCTA referrals with line of the current guidelines is recommended to improve quality and avoid the inappropriate requests and abuse of the CCTA modality. Additionally, for a fuller understanding of the appropriateness of CCTA referrals, it is required to come to a consensus on "uncertain" indicators in the recommendations, and until this occurs we need a local protocol for such cases.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

[1] Al Rawahi, A. H., Lee, P., Al Anqoudi, Z., Al Busaidi, A., Al Rabaani, M., Al Mahrouqi, F., & Al Busaidi, A. M. (2017).

Cardiovascular Disease Incidence and Risk Factor Patterns among Omanis with Type 2 Diabetes: A Retrospective Cohort Study. Oman medical journal, 32(2), 106–114. https://doi.org/10.5001/omj.2017.20

[2] El-Awa, F., Bettcher, D., Al-Lawati, J. A., Alebshehy, R., Gouda, H., & Fraser, C. P. (2020). The status of tobacco control in the Eastern Mediterranean Region: progress in the implementation of the MPOWER measures. Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit, 26(1), 102–109. https://doi.org/10.26719/2020.26.1.102

[3] World Health Organization. (2018). Noncommunicable diseases country profiles 2018. World Health Organization. https://apps.who.int/iris/handle/10665/274512. License: CC BY-NC-SA 3.0 IGO

[4] Nadar, S. K., Al-Riyami, H., Al-Riyami, A., Al-Lawati, H., Panakkal, B., Mohammed, S., Nagaraju, G. B., Sharma, S. N., Abdulkader, M. M., Beaney, T., Ster, A. C., & Poulter, N. R. (2020). May Measurement Month 2018: an analysis of blood pressure screening results from Oman. European heart journal supplements : journal of the European Society of Cardiology, 22(Suppl H), H100–H103. https://doi.org/10.1093/eurheartj/suaa039

[5] Al-Balushi, A., Al-Kindi, H., Al-Shuaili, H., Kumar, S., & Al-Maskari, S. (2015). Adolescents and adults with congenital heart diseases in oman. Oman medical journal, 30(1), 26–30. https://doi.org/10.5001/omj.2015.05

[6] Markwerth, P., Bajanowski, T., Tzimas, I., & Dettmeyer, R. (2021). Sudden cardiac death-update. *International journal of legal medicine*, *135*(2), 483–495. https://doi.org/10.1007/s00414-020-02481-z

[7] Ramjattan NA, Lala V, Kousa O, et al. Coronary CT Angiography. [Updated 2022 Jun 26]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470279/

[8] Oikonomou, E. K., West, H. W., & Antoniades, C. (2019). Cardiac Computed Tomography: Assessment of Coronary Inflammation and Other Plaque

Features. Arteriosclerosis, thrombosis, and vascular biology, 39(11), 2207–2219. https://doi.org/10.1161/ATVBAHA.119.312899

[9] Tesche, C., Bauer, M. J., Straube, F., Rogowski, S., Baumann, S., Renker, M., Fink, N., Schoepf, U. J., Hoffmann, E., & Ebersberger, U. (2022). Association of epicardial adipose tissue with coronary CT angiography plaque parameters on cardiovascular outcome in patients with and without diabetes mellitus. Atherosclerosis, S0021-9150(22)01477-0. Advance online publication. https://doi.org/10.1016/j.atherosclerosis.2022.10.006

[10] Haase, R., Schlattmann, P., Gueret, P., Andreini, D., Pontone, G., Alkadhi, H., Hausleiter, J., Garcia, M. J., Leschka, S., Meijboom, W. B., Zimmermann, E., Gerber, B., Schoepf, U. J., Shabestari, A. A., Nørgaard, B. L., Meijs, M., Sato, A., Ovrehus, K. A., Diederichsen, A., Jenkins, S., … COME-CCT Consortium (2019). Diagnosis of obstructive coronary artery disease using computed tomography angiography in patients with stable chest pain depending on clinical probability and in clinically important subgroups: meta-analysis of individual patient data. BMJ (Clinical research ed.), 365, l1945. https://doi.org/10.1136/bmj.l1945

[11] Cassar, A., Holmes, D. R., Jr, Rihal, C. S., & Gersh, B. J. (2009). Chronic coronary artery disease: diagnosis and management. Mayo Clinic proceedings, 84(12), 1130–1146. https://doi.org/10.4065/mcp.2009.0391

[12] Patel, M. R., Bailey, S. R., Bonow, R. O., Chambers, C. E., Chan, P. S., Dehmer, G. J., Kirtane, A. J., Wann, L. S., & Ward, R. P. (2012). ACCF/SCAI/AATS/AHA/ASE/ASNC/HFSA/HRS/SCCM/SCCT/SCMR/STS 2012 appropriate use criteria for diagnostic catheterization: a report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, Society for Cardiovascular Angiography and Interventions, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology,

Heart Failure Society of America, Heart Rhythm Society, Society of Critical Care Medicine, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. Journal of the American College of Cardiology, 59(22), 1995–2027. https://doi.org/10.1016/j.jacc.2012.03.003

[13] Patel MR, White RD, Abbara S, Bluemke DA, Herfkens RJ, Picard M, Shaw LJ, Silver M, Stillman AE, Udelson J. (2013) ACCF/ACR/ASE/ASNC/SCCT/SCMR appropriate utilization of cardiovascular imaging in heart failure: a joint report of the American College of Radiology Appropriateness Criteria Committee and the American College of Cardiology Foundation Appropriate Use Criteria Task Force. J Am Coll Cardiol 2013;61:2207–31. doi:10.1016/j.jacc.2013.02.005.

[14] Alderazi, A. A., & Lynch, M. (2017). An Audit on the Appropriateness of Coronary Computed Tomography Angiography Referrals in a Tertiary Cardiac Center. Heart views : the official journal of the Gulf Heart Association, 18(1), 8–12. https://doi.org/10.4103/1995-705X.206203

[15] Wasfy, M. M., Brady, T. J., Abbara, S., Nasir, K., Hoffmann, U., Cury, R. C., Di Carli, M. F., & Blankstein, R. (2012). Comparison of cardiac computed tomography examination appropriateness under the 2010 revised versus the 2006 original Appropriate Use Criteria. Journal of cardiovascular computed tomography, 6(2), 99–107. https://doi.org/10.1016/j.jcct.2011.12.005

[16] Rich, M. E., Utsunomiya, D., Simprini, L. A., Weigold, W. G., Weissman, G., & Taylor, A. J. (2012). Prospective evaluation of the updated 2010 ACCF Cardiac CT Appropriate Use Criteria. Journal of cardiovascular computed tomography, 6(2), 108–112. https://doi.org/10.1016/j.jcct.2012.02.003

[17] Bittner, D. O., Mayrhofer, T., Bamberg, F., Hallett, T. R., Janjua, S., Addison, D., Nagurney, J. T., Udelson, J. E., Lu, M. T., Truong, Q. A., Woodard, P. K., Hollander, J. E., Miller, C., Chang, A. M.,

Singh, H., Litt, H., Hoffmann, U., & Ferencik, M. (2017). Impact of Coronary Calcification on Clinical Management in Patients With Acute Chest Pain. Circulation. Cardiovascular imaging, 10(5), e005893. https://doi.org/10.1161/CIRCIMAGING.116.005893

[18] Chinnaiyan, K. M., Peyser, P., Goraya, T., Ananthasubramaniam, K., Gallagher, M., Depetris, A., Boura, J. A., Kazerooni, E., Poopat, C., Al-Mallah, M., Saba, S., Patel, S., Girard, S., Song, T., Share, D., & Raff, G. (2012). Impact of a continuous quality improvement initiative on appropriate use of coronary computed tomography angiography. Results from a multicenter, statewide registry, the Advanced Cardiovascular Imaging Consortium. Journal of the American College of Cardiology, 60(13), 1185–1191. https://doi.org/10.1016/j.jacc.2012.06.008

[19] Murphy, M. K., Brady, T. J., Nasir, K., Gazelle, G. S., Bamberg, F., Truong, Q. A., Mamuya, W. S., Abbara, S., Lee, T. H., & Blankstein, R. (2010). Appropriateness and utilization of cardiac CT: implications for development of future criteria. Journal of nuclear cardiology : official publication of the American Society of Nuclear Cardiology, 17(5), 881–889. https://doi.org/10.1007/s12350-010-9252-0

[20] Carpeggiani, C., Marraccini, P., Morales, M. A., Prediletto, R., Landi, P., & Picano, E. (2013). Inappropriateness of cardiovascular radiological imaging testing; a tertiary care referral center study. PloS one, 8(11), e81161. https://doi.org/10.1371/journal.pone.0081161

[21] Doris, M., & Newby, D. E. (2016). Coronary CT Angiography as a Diagnostic and Prognostic Tool: Perspectives from the SCOT-HEART Trial. Current cardiology reports, 18(2), 18. https://doi.org/10.1007/s11886-015-0695-4

[22] Brown JC, Gerhardt TE, Kwon E. Risk Factors For Coronary Artery Disease. [Updated 2022 Jun 5]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK554410/

[23] Spyropoulos, A. C., Lipardi, C., Xu, J., Lu, W., Suh, E., Yuan, Z., Levitan, B., Sugarmann, C., De Sanctis, Y., Spiro, T. E., Barnathan, E. S., & Raskob, G. E. (2019). Improved Benefit Risk Profile of Rivaroxaban in a Subpopulation of the MAGELLAN Study. Clinical and applied thrombosis/hemostasis : official journal of the International Academy of Clinical and Applied Thrombosis/Hemostasis, 25, 1076029619886022. https://doi.org/10.1177/1076029619886022

[24] Yancy CW, Jessup M, Bozkurt B, Butler J, Casey DE Jr, Colvin MM, Drazner MH, Filippatos GS, Fonarow GC, Givertz MM, Hollenberg SM, Lindenfeld J, Masoudi FA, McBride PE, Peterson PN, Stevenson LW, Westlake C. (2017) ACC/AHA/HFSA focused update of the 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Failure Society of America. Circulation. 136:e137–e161. DOI: 10.1161/CIR.0000000000000509.