

Audit on Risk Stratification and Follow-up of Pulmonary Embolism as per 2019 ESC guidelines

Matthew Grech, Giulia Stringaro, Etienne Ceci Bonello,
Emma Mifsud, Brendan Caruana Montaldo

Background: Pulmonary embolism is a common and potentially life-threatening disease. The aim of this audit is to determine whether the necessary investigations for risk stratification were taken, including troponin and N-terminal pro B-type natriuretic peptide to assess for heart strain and whether appropriate follow-up was provided with echocardiography and outpatients appointment as per 2019 ESC guidelines on pulmonary embolism.

Method: Retrospective review of computed tomography pulmonary angiographies (CTPA) performed from 1st July 2022 to 31st December 2022 at Mater Dei Hospital and Gozo General Hospital. Documentation on investigations carried out and appropriate follow-up were collected from Picture Archiving and Communication System (PACS) and iSOFT Clinical Manager.

Results: A total of 1682 CTPAs were carried out over the investigated period, out of which 12.8% (n=216) had a PE. Only 34.7% had troponin levels checked and 25.5% had NT-pro-BNP levels checked. Right heart strain was reported on CTPA in 13.9% of patients with a PE. In these patients, testing of cardiac biomarkers was higher with 70.0% of them having at least one cardiac biomarker tested. 30.1% of patients with PE had an echocardiogram done, most of which (73.8%) were as outpatients. More patients (56.7%) had an echo done when right heart strain was documented. Only 42.6% of patients had appropriate outpatients follow-up within 6 months of discharge.

Conclusion: A structured management plan in the form of local guidelines is necessary which will aid the emergency physician and also the internal medical clinician to treat and follow-up appropriately.

Dr Matthew Grech, MD

Primary Health Care,
Vincent Moran Regional Hub,
Paola, Malta

Dr Giulia Stringaro, MD, MRCP(UK)

Department of Haematology,
Mater Dei Hospital,
Msida, Malta

**Dr Etienne Ceci Bonello
BSc, MD, MRCP(UK), Resp Med (SCE)**

Department of Respiratory & General
Medicine,
Mater Dei Hospital,
Msida, Malta

**Dr Emma Louise Mifsud
MD, MRCP(UK), Resp Med (SCE)**

Department of Respiratory & General
Medicine,
Mater Dei Hospital,
Msida, Malta

**Dr Brendan Caruana Montaldo
MD, Dip ABIM, ABIM (Pulm Dis), ABIM
(Critical Care), ABSM**

Department of Respiratory & General
Medicine,
Mater Dei Hospital,
Msida, Malta

Pulmonary embolism is a common and potentially life-threatening disease which involves thrombosis of the pulmonary vasculature, most commonly arising from a deep vein thrombosis of the lower limbs or pelvis. Treatment delays in this condition can be fatal hence the importance of timely diagnosis and management cannot be overemphasised.

Apart from clinical evaluation of the patient, the 2019 ESC guidelines for the diagnosis and management of pulmonary embolism (PE) recommend diagnostic investigations for confirmation of PE diagnosis and risk stratification, some of which assess the effect of the embolism on the heart.¹

Evidence of heart strain may be assessed with blood tests, namely troponin and N-terminal pro B-type natriuretic peptide (NT-pro-BNP), and also with imaging, namely a computed tomography pulmonary angiography (CTPA).² According to the 2019 ESC guidelines, echocardiography is not required as a routine diagnostic work-up for patients with haemodynamically stable PE. However, in patients with evidence of heart strain as established by elevated cardiac biomarkers or on CTPA, echocardiography can be an additional aid to identify, and risk stratify the degree of heart strain.³ The investigation findings together with clinical assessment of the patient will assist the clinician to categorise the patient into high, intermediate, or low risk, hence influencing management, including the consideration of thrombolysis apart from anticoagulation.

Furthermore, guidelines also suggest that patients with PE should have a follow-up at 3-6 months to assess for dyspnoea and/or functional limitation. Therefore, risk stratification and appropriate follow up is necessary to determine the long-term management of such patients.

MATERIALS AND METHODS

The aim of this audit is to determine whether the necessary investigations for risk stratification and appropriate follow-up was provided to patients who developed pulmonary embolism as per 2019 ESC guidelines.

Retrospective review of CTPAs performed from 1st July 2022 to 31st December 2022 at Mater Dei

Hospital and Gozo General Hospital was done (n=1682), out of which 12.8% (n=216) were found to have PE. This information was collected using the Picture Archiving and Communication System (PACS). Documentation of right heart strain on CTPA reports was also noted via PACS.

Information with regards to patient demographics such as age, gender, investigations done, accident and emergency notes, and follow-up appointments was then gathered from the Mater Dei Hospital software including iSoft Clinical Manager and Electronic Case Summary (ECS). Permission for this audit was obtained from the Mater Dei Hospital (MDH) CEO, Legal office and Data Protection office. No ethical approval was required for this audit.

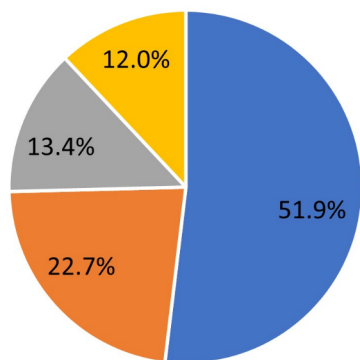
RESULTS

All CTPAs done between 1st July 2022 and 31st December 2022 were evaluated (n=1682), of which 12.8% were found to have a PE (n=216). Out of these, 52.8% (n=114) were female and 47.2% (n=102) were male. The mean age was 66 years.

Out of 216 positive CTPAs, 25.0% (n=54) had active malignancy, 14.8% (n=32) had a past history of venous thromboembolism, including DVT (n=15; 46.9%), PE (n=13; 40.6%) or both (n=4; 12.5%) and 21.8% (n=47) had a surgical procedure in the previous month, the majority of which were a total knee replacement (n=13; 27.7%).

From the CTPAs that were evaluated, 50.5% (n=109) were done at the accident and emergency department or within 24 hours of admission to hospital. 47.7% were done whilst the patient was an inpatient. In 4 patients (1.9%), the patient was not admitted after being found to have a PE. Out of those who had a PE-positive CTPA whilst they were an inpatient, the average length of stay prior to the CTPA was 7.9 days.

As recommended by the 2019 ESC guidelines, 2 cardiac biomarkers were taken into consideration in this audit: troponin and NT-pro-BNP. For these results to be included in the audit, the cardiac biomarkers must have been taken on the day of the CTPA or up to 24 hours after. Additionally, in cases where a second repeat troponin was taken, only the second troponin was taken into consideration.



■ None ■ Troponin only ■ NT-pro-BNP only ■ Both Troponin and NT-pro-BNP

Figure 1 Figure showing which cardiac biomarker has been tested in those who were found to have a PE on CTPA

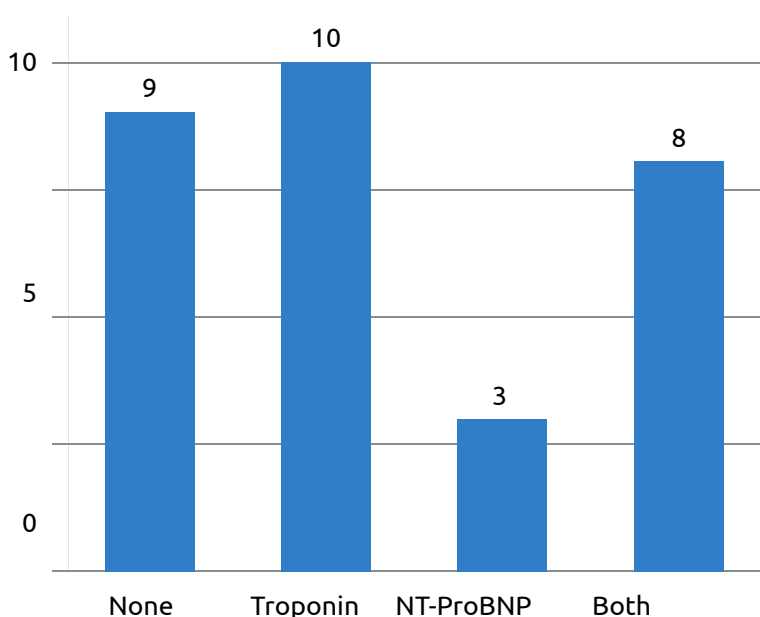


Figure 2 Figure showing which cardiac biomarkers were tested in patients who had PE with right heart strain

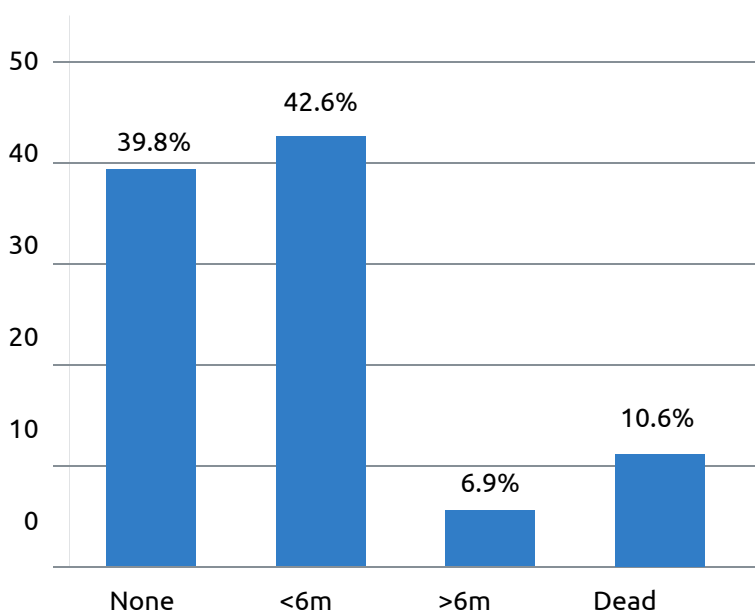


Figure 3 Figure showing follow-up percentages after PE diagnosis

75 patients (34.7%) from the total cohort had their troponin level checked of which 39 (52.0%) were elevated ($\geq 15\text{pg/ml}$). With regards to NT-pro-BNP, 55 patients (25.5%) had their levels checked, out of which 44 (80.0%) were elevated ($\geq 126\text{pg/ml}$). Out of the 216 patients who were found to have a PE, only 26 (12.0%) had both troponin and NT-pro-BNP levels checked on the day of the CTPA or up to 24 hours after (Figure 1).

With regards to identification of right heart strain, 30 patients (13.9%) were noted to have right heart strain on CTPA. From these, 21 (70.0%) had at least one cardiac biomarker checked (Figure 2).

Out of the 30 patients who had evidence of right heart strain on CTPA, only 1 patient underwent thrombolysis – the patient had a normal troponin (6) but an elevated NT-pro-BNP (933). From the 186 patients who had a PE but did not have evidence of right heart strain, only 1 patient underwent thrombolysis who was found to have an elevated troponin (110) but a normal NT-pro-BNP (72).

An echocardiogram was carried out in 30.1% (total = 65) of the patients who were found to have a PE either at A&E, as an inpatient or as an out-patient after the patient was discharged. From these, a total of 48 (73.8%) had the echo done as an out-patients while the rest (26.2%) were done at A&E or as an inpatient. Out of those patients who had documented right heart strain on CTPA, 17 patients (56.7%) had an echo done.

The 2019 ESC guidelines recommend a follow-up up within 6 months of PE diagnosis. With regards to this audit, follow-up with the caring medical firm or haematology are being taken as adequate follow ups. From the 216 patients who were found to have a PE, 23 (10.6%) of them had passed away during their admission thus a follow-up could not be provided to them. Out of the remaining 193 patients, only 47.7% (92 patients) were provided with a follow-up within 6 months of diagnosis (Figure 3).

DISCUSSION

Results of this audit show that risk stratification in PE using the cardiac biomarkers troponin and NT-pro-BNP was sub-optimal with more than half (51.9%) of

SUMMARY BOX

- We recommend testing of cardiac biomarkers, including troponin and NT-pro-BNP to assess for degree of heart strain in patients with PE.
- In those patients with elevated cardiac biomarkers or where heart strain is documented on CTPA, they should undergo echocardiography.
- When deciding treatment of PE such as with thrombolysis, the investigations should be taken into consideration with the clinical picture of the patient.
- Follow-up of patients with PE is necessary, ideally within 6 months to identify patients with persistent symptoms, those who are developing CTED/CTEPH and those who might benefit from pulmonary rehabilitation.

patients having neither of these investigations taken on the day that the CTPA was done and up to 24 hours after. In patients who had a PE, these cardiac biomarkers were elevated in the majority of patients, with troponin being elevated in 52.0% and NT-pro-BNP elevated in 80.0%, thus indicating possible cardiac compromise which can lead to an increased risk of clinical deterioration.⁴

Another important identifier for risk stratification is the presence or absence of right heart strain. Most of the time this was documented in the CTPA report. In those patients with PE and documented right heart strain, it was noted that the rate of testing for cardiac biomarkers was greater than in the general cohort with 70% of patients with right heart strain having had at least one cardiac biomarker tested.

The same trend can be seen with regards to echocardiography. In the general cohort, only 30.1% of the patients had an echo done during their stay in hospital or as an outpatients, however a greater proportion of patients (56.7%) had an echo when right heart strain was documented in the CTPA report. This indicates that documentation of right heart strain on CTPA makes clinicians more likely to assess for cardiac compromise using blood tests and imaging.

The majority of echocardiograms (73.8%) were done as an outpatients after the patient was discharged,

with the echo being booked upon discharge from their inpatient stay or booked when the patient is seen at outpatients.

The 2019 ESC guidelines on PE suggest that patients who are found to have a PE should have an outpatients follow-up within 3-6 months of diagnosis.⁵ In this audit, follow-up was only considered if it was with the caring medical firm or with haematology. Unfortunately, when excluding the patients who had passed away during their admission, less than half (47.7%) of patients had a follow-up that was within the 6-month time frame from when they were diagnosed.

The first limitation of the study is that it is retrospective. Data was collected from MDH software, and documentation may not have always been available, complete or documented appropriately. Another important limitation was that other co-morbidities that the patient suffered from, such as ischaemic heart disease and congestive heart failure were not taken into consideration, which may have independently contributed to an elevated troponin or NT-pro-BNP. Another limitation was that clinical assessment status was not taken into consideration in this audit, which in clinical practice is essential to guide the correct individualised management plan especially when considering thrombolysis.

CONCLUSION

Based on the results of this audit, in patients found to have a PE, appropriate risk stratification is vital, as well as thorough investigations using cardiac biomarkers and echocardiography when a CTPA shows heart strain. Likewise, it is important to follow-up such patients to assess for symptoms and functional limitation. The lack of follow up can result in morbidity and mortality especially from conditions such as chronic thromboembolic disease/pulmonary hypertension (CTED/CTEPH), which might result from PE, and which will go undiagnosed without appropriate follow up. Our recommendations are a structured management plan especially in the form of local guidelines, which will aid the emergency physician and also the internal medical clinician to treat and follow-up appropriately.

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