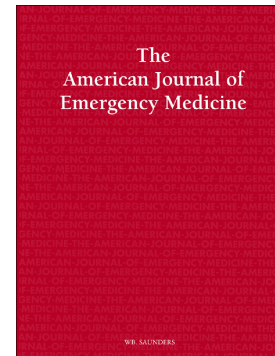


## Accepted Manuscript

A portrait of patients who die in-hospital from acute pulmonary embolism

Hesham R. Omar, Mehdi Mirsaeidi, Bishoy Abraham, Garrett Enten, Devanand Mangar, Enrico M. Camporesi



PII: S0735-6757(18)30172-4  
DOI: doi:[10.1016/j.ajem.2018.02.035](https://doi.org/10.1016/j.ajem.2018.02.035)  
Reference: YAJEM 57346

To appear in:

Received date: 16 February 2018  
Accepted date: 26 February 2018

Please cite this article as: Hesham R. Omar, Mehdi Mirsaeidi, Bishoy Abraham, Garrett Enten, Devanand Mangar, Enrico M. Camporesi, A portrait of patients who die in-hospital from acute pulmonary embolism. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Yajem(2017), doi:[10.1016/j.ajem.2018.02.035](https://doi.org/10.1016/j.ajem.2018.02.035)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

**A portrait of patients who die in-hospital from acute pulmonary embolism**

Hesham R. Omar [1], Mehdi Mirsaedi [2, 3], Bishoy Abraham [4], Garrett Enten [5], Devanand Mangar [6], Enrico M. Camporesi [7]

1. Internal Medicine Department, Mercy Medical Center, Clinton, Iowa, USA
2. Division of Pulmonary, Critical Care, Sleep and Allergy, University of Miami, Miller school of Medical, Florida, USA
3. Section of Pulmonary, Department of Medicine, Miami VA Medical Center, Miami, FL, USA
4. Research Associate, Tampa General Hospital, Tampa, Florida, USA
5. Research Associate, Tampa General Hospital, Tampa, Florida, USA.
6. Chief of Anesthesia, Tampa General Hospital; CEO, FGTBA and Regional Medical Director, TEAMHealth, Tampa, Florida, USA
7. Professor of Surgery/Anesthesiology, Professor of Molecular Pharmacology and Physiology, University of South Florida, FGTBA and TEAMHealth, Tampa, Florida, USA.

\*Corresponding author

Hesham R. Omar

Internal Medicine Department

Mercy Medical Center, Clinton, Iowa, USA

Cell: 312-714-9272, Email: hesham\_omar2003@yahoo.com

**A portrait of patients who die in-hospital from acute pulmonary embolism**

ACCEPTED MANUSCRIPT

Acute pulmonary embolism (APE) is a prevalent disease occurring in 100–200/100,000 inhabitants/year with a high mortality rate of 17.4% at 90-days in the unselected population [1]. The predictors of early death after APE include advanced age, comorbidities, and clinical picture at presentation [2], where mortality ranges from 8.1% with right ventricular dysfunction to 24.5% in cardiogenic shock and 64.8% in cases requiring cardiopulmonary resuscitation [3]. Herein, we present the characteristics of a series of patients who died in-hospital from APE.

We retrospectively reviewed charts of 17 adult cases (>18 years) who died in the period from 2010-2015 at Tampa General Hospital from APE that was confirmed by computed tomography angiogram (CTA). Continuous variables will be presented as median and interquartile range (IQR) and categorical variables will be listed as counts and percentages. Patients presented to the emergency room within 2.5 (1, 5.8) hours from symptom onset and the diagnosis of APE was established within 5 (2, 13) hours from arrival to emergency room. Death occurred within a median of 6 days since arrival to the emergency room. In 53% of the cases, the diagnosis of APE was established by emergency physician and in 47% by floor physician. 77% of the cases were classified to have either massive or submassive APE and 47% (8/17) were considered to have massive APE due to requirement of pressor support [4].

Analysis of patients' demographics showed a median age of 68 (57, 74) years, with a body mass index of 28 (24, 32) Kg/m<sup>2</sup>, 65% were men, 60% were white, 35% were smokers, 29% had history of cancer, and 41% had history of prior venous thromboembolism. 25% of the cases had orthopedic surgery in the preceding 90 days. With regards to the clinical presentation, 71% complained of chest pain, 47% had dyspnea and one case had syncope and one had presyncope as the main presenting complain. 35% were tachycardic on admission with 18% developing a

new onset atrial fibrillation, and 24% had an admission oxygen saturation <88%. Imaging showed that 46% had right ventricular dilation and/or hypokinesis on echocardiogram and 36% had concomitant deep venous thrombosis. 70% of the cases required either bi-level positive airway pressure (BiPAP) support (41%) or mechanical ventilation (29%). The duration of hospitalization was 6 (2, 28) days.

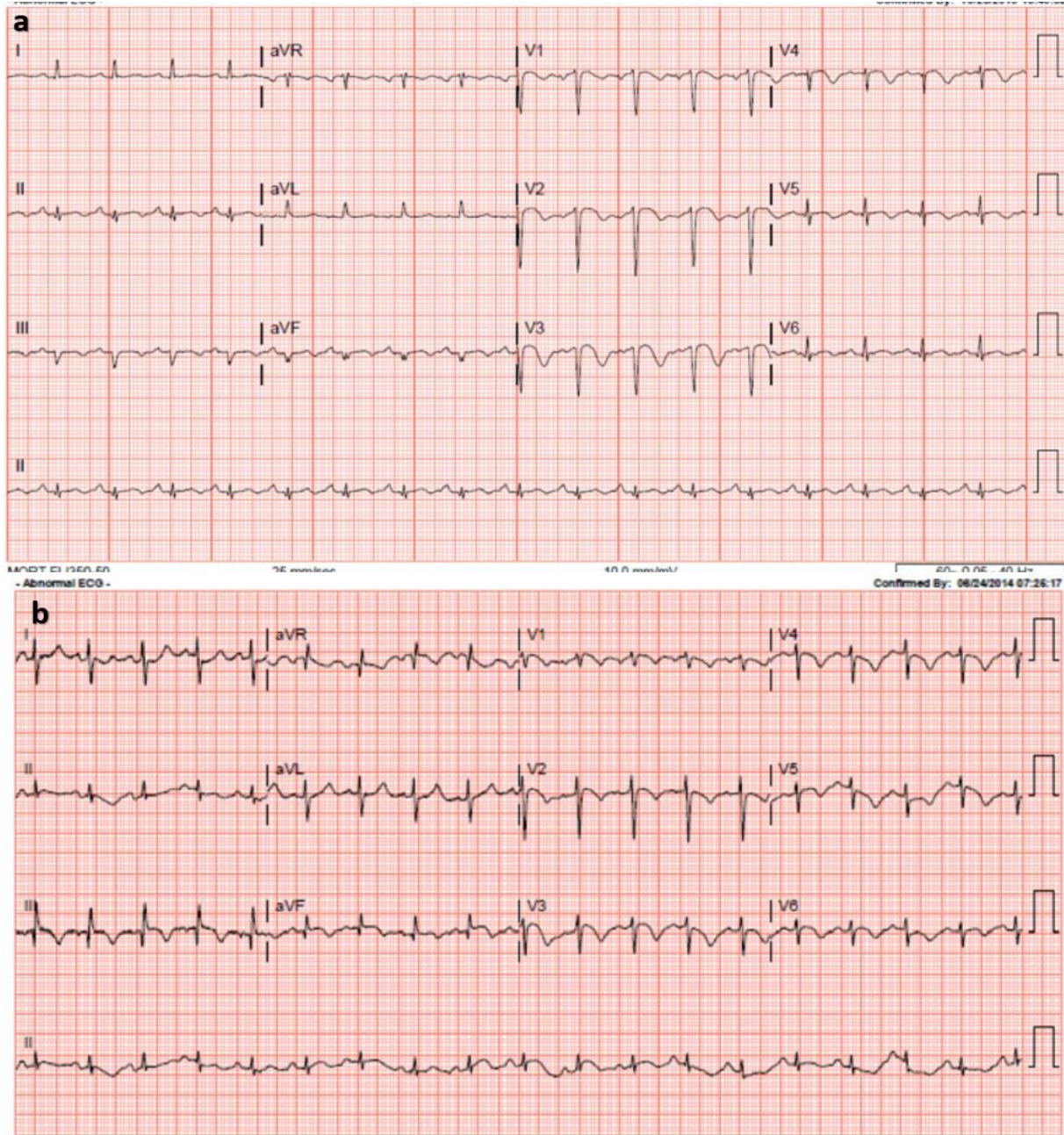
15 cases had available electrocardiogram (EKG) on admission and only 13 cases were analyzed with respect to their EKG features after excluding 2 cases with left bundle branch block and paced ventricular rhythm. The commonest ECG abnormality was tachycardia whether sinus tachycardia which was present in 53% (8/15). This was followed in descending order by ST-segment elevation in lead V1 which was present in 46% (6/13) of the cases, ST-segment elevation in both V1 and aVR in 38% (5/13), poor R wave progression in 38% (5/13), ST-segment depression in V4-V6 in 36% (5/14), T wave inversion in inferior leads in 31% (4/13), ST-segment elevation in leads III, V1 and aVR in 23% (3/13), right axis deviation in 23% (3/13), ST-segment elevation in V1-V4 in 15% (2/13), ST-segment elevation in inferior leads in 15% (2/13), T-wave inversion in V1-V4 in 15% (2/13), S1Q3T3 pattern in 15% (2/13), QTc prolongation in 15% (2/13), and 15% (2/13) had  $\geq 9/12$  leads with T-wave inversion. Figure 1 shows an example of 2 different EKGs patterns encountered on admission in patients who die in-hospital from APE.

Prior work showed that two out of every three patients succumbing to APE die within two hours after presentation, and that 10% of APE is fatal in the first hour [5]. Stulz and colleagues also showed that in patients with massive APE, 50% die within 30 min, 70% die within 1 h, and more than 85% die within 6 h of the onset of symptoms [6]. In our cohort, death

occurred within a median of 6 days since arrival to the emergency room and only 2 cases (12%) died in the first 24 hours (19 and 22h). The early presentation to the emergency room within a median of 2.5 hours of the onset of symptoms allowed for early diagnosis and treatment, likely leading to significant reduction in mortality and absence of death very early in the course of disease, despite that half the cases in our cohort were classified to have massive APE. These cases presented early likely due to the notable degree of hemodynamic instability evident in the requirement of 70% of the cases to either Bipap or mechanical ventilation support and pressors ~ in half the cases. Surprisingly, despite this degree of hemodynamic instability in the majority of our cases, and the fact that emergency physicians tend to utilize CTA excessively to rule out APE (one-third of imaging performed in the emergency for suspected APE is categorized as avoidable [7]), only ~ half of the cases in our cohort were diagnosed by emergency physicians. This conforms with prior observations which show that half of the cases with APE get diagnosed with initiation of treatment in the emergency room [8, 9], suggesting that symptoms and signs of APE are nonspecific in significant portion of cases. Although on-admission EKG in this cohort exemplify its low sensitivity in identifying future non-survivors, certain findings occurred with high frequency including ST-segment elevation in lead V1 which was present in 46% and ST-segment elevation in both V1 and aVR which occurred in 38% in our cohort, which at-least support prior data showing that these two signs were independent predictors of death and complications during hospitalization in APE, respectively [10]. This descriptive-only analysis allows the awareness of characteristics of this group of patients with APE at high risk of death, which may help early diagnosis and treatment hoping to improve outcomes.

## References

1. Belohlavek, J., V. Dytrych, and A. Linhart, *Pulmonary embolism, part I: Epidemiology, risk factors and risk stratification, pathophysiology, clinical presentation, diagnosis and nonthrombotic pulmonary embolism*. *Exp Clin Cardiol*, 2013. **18**(2): p. 129-38.
2. Goldhaber, S.Z., L. Visani, and M. De Rosa, *Acute pulmonary embolism: clinical outcomes in the International Cooperative Pulmonary Embolism Registry (ICOPER)*. *Lancet*, 1999. **353**(9162): p. 1386-9.
3. Kasper, W., et al., *Management strategies and determinants of outcome in acute major pulmonary embolism: results of a multicenter registry*. *J Am Coll Cardiol*, 1997. **30**(5): p. 1165-71.
4. Jaff, M.R., et al., *Management of massive and submassive pulmonary embolism, iliofemoral deep vein thrombosis, and chronic thromboembolic pulmonary hypertension: a scientific statement from the American Heart Association*. *Circulation*, 2011. **123**(16): p. 1788-830.
5. Kearon, C., *Natural history of venous thromboembolism*. *Circulation*, 2003. **107**(23 Suppl 1): p. I22-30.
6. Stulz, P., et al., *Decision making in the surgical treatment of massive pulmonary embolism*. *Eur J Cardiothorac Surg*, 1994. **8**(4): p. 188-93.
7. Venkatesh, A.K., et al., *Evaluation of pulmonary embolism in the emergency department and consistency with a national quality measure: quantifying the opportunity for improvement*. *Arch Intern Med*, 2012. **172**(13): p. 1028-32.
8. Jones, A.E. and J.A. Kline, *Availability of technology to evaluate for pulmonary embolism in academic emergency departments in the United States*. *J Thromb Haemost*, 2003. **1**(10): p. 2240-2.
9. Pollack, C.V., et al., *Clinical characteristics, management, and outcomes of patients diagnosed with acute pulmonary embolism in the emergency department: initial report of EMPEROR (Multicenter Emergency Medicine Pulmonary Embolism in the Real World Registry)*. *J Am Coll Cardiol*, 2011. **57**(6): p. 700-6.
10. Kukla, P., et al., *Electrocardiography and prognosis of patients with acute pulmonary embolism*. *Cardiol J*, 2011. **18**(6): p. 648-53.



**Figure 1:** 12-lead electrocardiograms of 2 patients who die in-hospital from acute pulmonary embolism showing ST-segment elevation and T-wave inversion in precordial leads (panel a) and S1 Q3 T3 pattern with T wave inversion in precordial leads (panel b).