

Importance of Diagnostic Imaging Training for Intensivists: Lessons Learned From a Case

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Abstract

Intensive care physicians are tasked with managing patients with complex organ disorders, necessitating a broad skill set and ongoing education. While simulation training often focuses on equipment handling, this case report highlights a critical instance of acute aortic dissection initially missed on imaging during intensive care unit (ICU) admission. An 86-year-old woman with multiple comorbidities presented with respiratory symptoms and electrolyte imbalances, ultimately requiring ICU admission. Despite initial inconclusive imaging and treatment for suspected conditions, further evaluation revealed a dissecting aneurysm of the descending aorta. This case underscores the importance of thorough diagnostic evaluation and ongoing vigilance, especially in older adults with multiple health conditions. It emphasizes the need for comprehensive education, including proactive training in image diagnosis, to recognize diverse medical presentations and potential complications. This case serves as a reminder of the evolving challenges in critical care and the necessity for continuous education and adaptability to ensure optimal patient outcomes.

Categories: Medical Education

Keywords: physician, training, diagnostic imaging, intensive care medicine, education

Introduction

Intensive care physicians often have to manage patients with serious organ disorders and therefore require a diverse range of knowledge and skills. The unique nature of every patient's clinical course requires healthcare providers to be sufficiently trained through simulation education and hands-on seminars [1,2]. However, at present, much of this training is focused on handling equipment such as ventilators [3], extracorporeal membrane oxygenation machines [4], and echocardiography [5]. This article reports a case of acute aortic dissection that could not be detected on image diagnosis during intensive care unit (ICU) admission.

Case Presentation

An 86-year-old woman with a history of hypertension, nephrotic syndrome, and aortic valve stenosis initially sought medical attention for right knee pain and underwent temporary hospitalization and arthroscopic debris cleaning due to the presence of methicillin-sensitive *Staphylococcus aureus* in the synovial fluid. Post-surgery, she showed electrolyte imbalances, hyponatremia, and pleural effusion. She received steroid cover for suspected secondary adrenocortical insufficiency. However, the persistent anemia and respiratory symptoms ultimately necessitated admission to the ICU.

Clinical findings on ICU admission were as follows: blood pressure, 169/67 mmHg; heart rate, 100 beats/minute; respiratory rate, 24 breaths/minute; oxygen saturation, 99% with a high-flow nasal cannula (fraction of inspired oxygen, 0.7, 50 L/minute); partial arterial oxygen pressure, 150 mmHg; partial arterial pressure of carbon dioxide, 44 mmHg; pH, 7.54; base excess, 14 mmol/L; lactate, 12 mg/dL; sodium, 120 mEq/L; potassium, 2.3 mEq/L; and chlorine, 78 mEq/L (Table 1).

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Variables	Measurements	Reference range
Blood pressure	169/67 mmHg	
Heart rate	100 beats/minute	
Respiratory rate	24 beats/minute	
Oxygen high-flow nasal cannula	Gas flow: 50 L/minute; fraction of inspired oxygen: 0.7	
Arterial blood gas analysis		
Partial pressure of oxygen	150 mmHg	80–100
Partial pressure of carbon dioxide	44 mmHg	35–45
pH	7.54	7.350–7.450
Base excess	14 mmol/L	-2.0–2.0
Lactate	12 mg/dL	5–14
Sodium	120 mEq/L	136–146
Potassium	2.3 mEq/L	3.4–4.5
Chlorine	78 mEq/L	98–106

TABLE 1: Clinical findings on intensive care unit admission.

Chest computed tomography (CT) revealed bilateral ground-glass opacities with reticular opacities in both lungs and bilateral pleural effusions. Treatment for acute respiratory failure, hyponatremia, hypokalemia, and adrenal insufficiency associated with exacerbation of acute heart failure was initiated. Gram-positive cocci were detected in the blood culture taken upon ICU admission.

Contrast-enhanced CT to identify infection foci showed no obvious lesions. In the differential diagnosis of bacteremia, infective endocarditis and pyogenic spondylitis were considered. Echocardiography revealed no obvious lesions, and magnetic resonance imaging (MRI) indicated a diagnosis of pyogenic spondylitis. No suspicious findings were observed. Administration of diuretics and thoracentesis tended to improve the heart and respiratory failure, and the patient was discharged from the ICU on the sixth hospital day because her respiratory condition was stable with nasal cannula therapy at 3 L/minute and hemodynamics were stable. However, MRI interpretation by the radiology department indicated a dissecting aneurysm of the descending aorta (Figure 1). At this point, we looked back at the CT scans we had taken previously and found a similar dissecting aneurysm in the descending aorta (Figure 2). Consultation with a cardiovascular surgeon indicated that instead of a typical aortic dissection in the descending aorta, this was a tear in a heavily calcified part of the intima causing leakage of blood. Although the tear was limited, blood pressure management was required to avert a rupture.

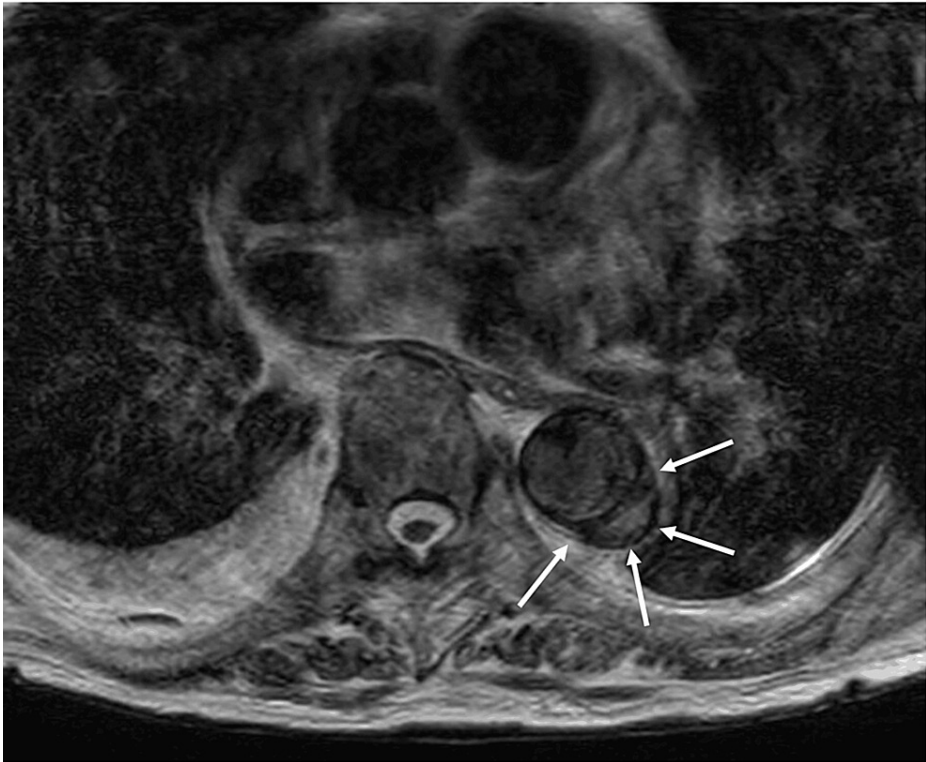


FIGURE 1: Magnetic resonance imaging of the descending aorta.

T2 axial magnetic resonance imaging with white arrows showing a localized descending aortic dissecting aneurysm.



FIGURE 2: Contrast-enhanced computed tomography of the chest.

The white arrows show a localized descending aortic dissecting aneurysm.

Discussion

In this case, two discernible findings have emerged, each bearing substantial implications for the realm of intensive care medicine. First, our report underscores the imperative integration of diagnostic imaging into the pedagogical framework designed for the enlightenment of intensive care practitioners. Second, the exigencies encountered in managing the aforementioned case highlight the escalating demand for an expanded repertoire of skills and knowledge within the purview of intensive care medicine.

This case accentuates a critical lacuna in the current training paradigm, suggesting a pressing need for augmented emphasis on the interpretation and application of diagnostic imaging techniques among intensivists. This finding underscores the necessity for intensivists to possess adept skills in interpreting

imaging results to facilitate timely and accurate diagnosis. The significance of integrating imaging education into intensive care training programs has been emphasized [6]. Incorporating simulation-based training in radiology interpretation for critical care fellows leads to improved diagnostic accuracy and confidence levels among participants [7].

Moreover, the multifaceted clinical trajectory, characterized by a confluence of organ dysfunctions and diagnostic conundrums, underscores the indispensable requirement for intensivists to navigate an increasingly complex landscape with expertise. This case further delineates the demand for intensified skill sets and knowledge among intensive care physicians. Intensive care medicine has evolved into a dynamic discipline characterized by the complexity of patient presentations and the advent of advanced technologies and treatment modalities [8,9]. The evolving landscape necessitates a comprehensive understanding of diverse medical domains, ranging from cardiovascular physiology to infectious disease management. Moreover, the acquisition of advanced skills beyond traditional intensive care realms is needed to underscore the correlation between intensified training in critical care and improved patient outcomes [10]. The dynamic and multifaceted nature of critical care practice necessitates a holistic understanding of diverse medical domains to effectively address the evolving needs of critically ill patients.

Conclusions

This case provides a reminder of the unique challenges encountered in each case and the need for a comprehensive and adaptable approach for optimal patient care. These lessons can contribute to the evolution of healthcare practices and underscore the importance of continuous education and adaptability to meet evolving medical challenges.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Acquisition, analysis, or interpretation of data: Masayuki Akatsuka, Akira Hasebe, Naoya Yama

Drafting of the manuscript: Masayuki Akatsuka, Akira Hasebe

Critical review of the manuscript for important intellectual content: Masayuki Akatsuka, Naoya Yama

Disclosures

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References

1. Ramar K, De Moraes AG, Selim B, Holets S, Oeckler R: Effectiveness of hands-on tutoring and guided self-directed learning versus self-directed learning alone to educate critical care fellows on mechanical ventilation - a pilot project. *Med Educ Online*. 2016, 21:32727. [10.3402/meo.v21.32727](https://doi.org/10.3402/meo.v21.32727)
2. Gerretsen EC, Chen A, Annema JT, Groenier M, van der Heijden EH, van Mook WN, Smeenk FW: Effectiveness of flexible bronchoscopy simulation-based training: a systematic review. *Chest*. 2023, 164:952-62. [10.1016/j.chest.2023.05.012](https://doi.org/10.1016/j.chest.2023.05.012)
3. Keller JM, Claar D, Ferreira JC, et al.: Mechanical ventilation training during graduate medical education: perspectives and review of the literature. *J Grad Med Educ*. 2019, 11:389-401. [10.4300/JGME-D-18-00828.1](https://doi.org/10.4300/JGME-D-18-00828.1)
4. Golcink A, Berden J, Goslar T, Gorjup V: High fidelity ECMO simulation: a reality check with reality-use of simulation in ECMO teaching program. *J Artif Organs*. 2023, 26:36-44. [10.1007/s10047-022-01336-1](https://doi.org/10.1007/s10047-022-01336-1)
5. Pezel T, Dreyfus J, Mouhat B, et al.: Effectiveness of simulation-based training on transesophageal echocardiography learning: the SIMULATOR randomized clinical trial. *JAMA Cardiol*. 2023, 8:248-56. [10.1001/jamacardio.2022.5016](https://doi.org/10.1001/jamacardio.2022.5016)
6. Siström CL, Slater RM, Rajderkar DA, Grajo JR, Rees JH, Mancuso AA: Full resolution simulation for evaluation of critical care imaging interpretation; part 2: random effects reveal the interplay between case difficulty, resident competence, and the training environment. *Acad Radiol*. 2020, 27:1016-24. [10.1016/j.acra.2019.11.025](https://doi.org/10.1016/j.acra.2019.11.025)

7. Raviprasad AG, Pierre K, McCaugh SA, et al.: Radiology resident competency in detecting basilar artery occlusion: a simulation-based assessment. *Emerg Radiol.* 2024, 31:1-6. [10.1007/s10140-023-02189-8](https://doi.org/10.1007/s10140-023-02189-8)
8. Kadri SS, Rhee C, Strich JR, et al.: Estimating ten-year trends in septic shock incidence and mortality in United States academic medical centers using clinical data. *Chest.* 2017, 151:278-85. [10.1016/j.chest.2016.07.010](https://doi.org/10.1016/j.chest.2016.07.010)
9. Rhee C, Dantes R, Epstein L, et al.: Incidence and trends of sepsis in US hospitals using clinical vs claims data, 2009-2014. *JAMA.* 2017, 318:1241-9. [10.1001/jama.2017.13836](https://doi.org/10.1001/jama.2017.13836)
10. Honarmand K, Wax RS, Penoyer D, et al.: Society of Critical Care Medicine guidelines on recognizing and responding to clinical deterioration outside the ICU: 2023. *Crit Care Med.* 2024, 52:314-30. [10.1097/CCM.0000000000006072](https://doi.org/10.1097/CCM.0000000000006072)