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Review Article

Differentiating causes of Dyspnea in emergency and its management

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ABSTRACT

The perception of inadequate or labored breathing is called dyspnea. Acute dyspnea in emergency merits immediate treatment for maintaining airway, breathing and circulation before proceeding to investigations and treatment of underlying pathology. This article aims to help the clinician identify the various etiological factors of dyspnea in the emergency setting, and how to triage patients and manage accordingly. Besides the usual cardiac and pulmonary causes of dyspnea, here we discuss other etiologies often encountered in emergency departments like renal, metabolic, neuromuscular, throat, neck and mental disorders.

1. Introduction

Dyspnea refers to the subjective sensation of difficulty breathing, air hunger, or tightness in the chest.[1] Roughly one-fourth of patients admitted from the emergency department (ED) report experiencing breathlessness.[2] It is also a frequent complaint among 25% of patients in outpatient settings.[3] As a symptom rather than a disease, dyspnea can stem from various sources such as cardiac, respiratory, renal, metabolic, throat, neuromuscular, or psychogenic conditions.[4] Prompt and accurate diagnosis and treatment are crucial for saving lives in cases of acute dyspnea.[5]

A multicenter investigation revealed that dyspnea is a prevalent reason for ED visits, accounting for 10% of ward and 20% of ICU admissions, respectively.[6] Although cardiac and respiratory issues were the primary culprits, 20% of cases involved other pathologies. Notably, 60% of patients were over the age of 60 and often presented with multiple comorbidities.[7] Additionally, a separate study identified dyspnea as a common issue in young children aged 0 to 4 years.

The objective of this article is to devise a strategy for effectively differentiating and diagnosing critically ill patients and providing early treatment, particularly in settings with limited resources. This emphasis is crucial as initial misdiagnosis can lead to prolonged hospital stays and significantly reduced survival rates.

2. Review of Literature

2.1. Why to differentiate the causes of dyspnea?

In emergencies, chief complaints play a crucial role in guiding further management, yet there remains a lack of substantiation concerning the strength of the association of primary complaints with probable diagnoses.[8] For patients presenting with dyspnea, identifying the underlying cause poses a significant challenge due to the multitude of possible illnesses it may signify.

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The origins of dyspnea may stem from various sources. Cardiac issues such as acute decompensated heart failure, diastolic heart failure, tamponade, acute coronary syndrome, ischemic cardiomyopathy, valvular heart defects, and arrhythmias like atrial fibrillation or flutter can all contribute to breathlessness.

Respiratory conditions including acute bronchitis, pneumonia, bronchial asthma, pleural effusion, pneumothorax, acute interstitial syndrome, chronic obstructive pulmonary disease, acute pulmonary embolism, volume overload pulmonary edema, lung malignancies, and aspiration can also manifest as dyspnea.

Additionally, dyspnea may be indicative of other common issues such as renal dysfunction (acute and chronic kidney disease), metabolic disorders (diabetic ketoacidosis), anemia, mental health disorders (anxiety, panic attacks, somatization, or functional disorders), neuromuscular diseases (myasthenia gravis, Guillain-Barre syndrome), or poisoning (carbon monoxide).

Throat conditions including congenital malformations like laryngomalacia, laryngeal web, growths in the oropharynx or larynx such as papilloma or malignancies, vocal cord paralysis, laryngotracheal stenosis, foreign body causing airway obstruction, infections of the larynx, epiglottitis, and angioedema can also lead to dyspnea. Neck issues such as thyroid swelling, neck abscesses, or chemical or physical traumas should also be considered.

Finally, iatrogenic causes and medications such as beta-blockers, ticagrelor, and post-operative complications like thyroidectomy should always be taken into account when assessing dyspnea.

The verbal dyspnea score (VDS) has both subjective and objective parameters that are useful in assessing and prioritizing rapid decisions in an emergency. The study using this score for possible admission prediction of dyspnea patients found that score >8 predicted inpatient admission with 89% specificity whereas <3 predicted a safe discharge from the hospital with 95% specificity.[9]

2.2. How does the patient with dyspnea present?

The patient may present with a narrative encompassing symptoms such as shortness of breath (SOB), laborious respiration, sensations of choking, heightened effort in breathing, tightness in the chest, and a sense of air hunger, whether experienced at rest or during physical exertion. The onset and duration of symptoms, whether sudden or gradual, are pertinent details to gather. Additionally, noting whether symptoms occur intermittently or persistently is crucial. Inquiry into associated symptoms like fever, cough, hemoptysis, chest pain, previous history of heart disease, hoarseness, exposure to allergens, or trauma should be conducted. Past medical history, including medication usage, history of airway surgeries, or prolonged periods of immobilization, may provide valuable insights into underlying conditions. Notably, a history of tobacco use often correlates with various chronic diseases. It's also important to inquire about vaccination history, including vaccines against coronavirus, influenza, and pneumococcus.

Dyspnea experienced during exertion or at high altitudes is generally regarded as physiological, stemming from deconditioning, which arises from a lack of sustained physical activity. This sequence of dyspnea associated with diminished movement, deconditioning, and subsequent exacerbation of dyspnea is widely documented as a significant factor in the functional decline commonly associated with the natural aging process.[10]

Moreover, the nature and amount of dyspnea for a given level of activity are believed to be influenced by factors such as patient expectations, behavioral tendencies, and emotional status.[11] Consequently, individuals who exhibit greater dependency, anxiety, and excessive focus on their health may perceive more dyspnea even with comparatively inconsequential increases in ventilatory resistance.

During pregnancy, dyspnea affects approximately two-thirds of individuals, primarily due to physiological changes such as decreased hematocrit levels and elevation of the diaphragm. This manifestation is typically considered a normal physiological response.

2.3. How to grade the severity of dyspnea?

Various tools are available to assess the severity of dyspnea, including the visual analog scale (range 1 to 10, with 1 representing barely noticeable dyspnea and 10 representing panic or suffocation), the Borg scale (range 6 to 20, gauges perceived physical exertion during activity), and the multidimensional dyspnea profile, as documented in the literature.[12]

However, many of these scales primarily focus on the intensity of tasks that induce dyspnea, which may limit their utility. Patients often self-minimize the intensity of their exertion, while others may misjudge their capability to exercise. To address these limitations, symptoms can be directly evaluated through supervised tasks such as cycle ergometry, the 6-minute walk test, and the methacholine challenge.

2.4. What is all to be examined in patients with dyspnea?

The emergency physician must initially assess for signs such as confusion, pronounced cyanosis, dyspnea while speaking, and diminished respiratory effort, which serve as alarm signals indicating potential life-threatening conditions. The examination should include observation of the patient's posture (notably tripoding, except in cases of hepatopulmonary syndrome), respiratory rate (evaluating for tachypnea), blood pressure, heart rate, temperature, pallor, pulse oximetry readings, accessory muscle usage,

Table 1: History andexamination findings helpful in gauging the severity of dyspnea

Symptom	Mild	Moderate	Severe
Activity causing breathlessness	While walking	While talking	Even at rest
Speech of the patient	Can speak in sentences	In phrases	Only in few words (fragmented speech)
Alertness	Maybe agitated but fully alert	Usually agitated	Usually agitated/ confused
Respiratory rate (normal is 12 to 22 breaths/min)	Increased	Increased	>30 breaths/minute
Accessory muscle use	Not seen	Commonly seen	Always seen (nasal flaring, mouth opening, contracting sternocleidomastoid and trapezius)
Heart rate (pulse/minute)	<100	100-120	>120
Oxygen saturation (SpO2)	>95	92-94	<90

emotional status, ability to speak, presence of cardiac murmurs, arrhythmias, or muffled heart sounds, displaced apex beat, peripheral edema, jugular venous pressure, and auscultation of chest sounds (noting any decrease or presence of wheezes/rales) and fiberoptic laryngoscopy.

The upright position of the upper body aids in reducing the work of breathing and preventing exhaustion, whether the patient is at rest (using positioning aids in bed or sitting with arms abducted to expand the thorax) or engaged in standing and walking (utilizing support such as a walker with arms supported). Respiratory rate is assessed by examining chest and abdominal movements for one minute.[13] Signs such as recession in the suprasternal fossa, tracheal tug, and intercostal retraction may indicate increased respiratory effort, though these may not be present in patients with neuromuscular disease due to muscle weakness.

Pursed lip breathing, often observed in cases with chronic obstructive pulmonary disease (COPD), aids by prolonging expiratory time and increasing tidal volumes. The presence and pattern of stridor should be examined, noting whether it is expiratory (indicative of lower airway obstruction), inspiratory (suggestive of supraglottic airway compromise), or biphasic (indicating glottic pathology). The neck should be carefully examined for signs of swelling, tenderness, crepitus, or hemorrhage, especially in cases with a history of trauma. Additionally, a neck examination is essential to rule out crepitus, bruising, thyroid enlargement, tracheal deviation, and jugular venous distension. Abdominal examination should include assessment for distension, masses, or tenderness, while the legs should be inspected for tenderness and swelling to rule out deep vein thrombosis, which could lead to pulmonary embolism.

2.5. What tests should be done?

The initial diagnostic assessment should encompass a comprehensive set of tests, including a complete blood count (to evaluate hemoglobin, hematocrit, and white blood cell count), met hemoglobin levels, blood glucose levels, renal function tests, thyroid function tests, and D-dimer levels. D-dimers, while possessing a high negative predictive value for pulmonary embolism due to concurrent activation of coagulation and fibrinolysis, are not suitable as screening tests, as high levels may be indicative of cancer, inflammation, or infections.[14]

Arterial blood gas analysis is essential, as both an increase in PaCO2 and a decrease in PaO2 can result in sensations of air hunger. Even a modest increase in PaCO2 by 4 mmHg is more stimulating than a decrease in PaO2 down to 60 mmHg. A pH level of ≤7.39 carries a high mortality rate of 37% within 12 months.[15,16] Increased hydrogen ion concentration stimulates medullary chemoreceptors, leading to dyspnea in conditions such as diabetic ketoacidosis and renal insufficiency.

Additional investigations should include a chest X-ray (to assess for consolidation, pleural effusion, pneumothorax, and cardiac size), 12-lead electrocardiography (to detect dysrhythmias or acute coronary syndrome affecting perfusion), echocardiography (for evaluating ejection fraction, valve function, ventricle dimensions, and cardiac wall motion abnormalities), bedside lung ultrasonography (to rule out pleural effusion, alveolar consolidation, and pneumothorax, with reported high sensitivity and specificity), inferior vena cava ultrasonography (to assess central venous pressure), renal ultrasonography, pulmonary function tests (with dyspnea often occurring when tidal volume is reduced by 30%), and assessment of lung function following inhaled bronchodilator administration, which may suggest reversible airway obstruction.[17,18]

A recent study proposes integrating focused multiorgan ultrasonography (USG) as part of the diagnostic approach to differentiate the causes of dyspnea in emergency settings.[19] This approach includes heart echocardiography, lung, kidney, and neck USG. Notably, the diagnosis of dyspnea stemming from mental illness should be made only after extensive somatic work-up has yielded normal results.

Further targeted testing should be individualized based on astute clinical judgment, as indiscriminate testing may

lead to unnecessary delays in management and strain on healthcare resources. Specific cardiac biomarkers such as brain natriuretic peptides are valuable for excluding congestive heart failure.[20] However, it's essential to note that levels of these biomarkers may also be elevated in kidney disease, while obesity may lower them.

In cases where myocardial ischemia is suspected, serial evaluation of cardiac troponin I or T can aid in diagnosis, with a positive predictive value of 80%. However, elevated cardiac troponins may also be indicative of a multitude of other conditions such as pulmonary embolism, sepsis and renal failure.[21,22] Additionally, cardiac troponins play a role in risk stratification, as higher concentrations are associated with increased mortality.[23]

2.6. What treatment should be given?

Once the likely cause of dyspnea has been identified within a specific system, further diagnostic testing may be warranted. This could involve procedures such as biopsy of a laryngeal growth, CT scans of the neck or chest, bronchoscopy to detect foreign bodies in the bronchi, or culture sensitivity testing of sputum or bronchoalveolar lavage. Invasive procedures like right and left heart catheterization may also be performed for hemodynamic assessment.

In cases of anemia, a comprehensive array of tests including serum ferritin, transferrin, reticulocyte count, B12 levels, blood smear examination, bone marrow puncture, hemoglobin electrophoresis, lactate dehydrogenase, haptoglobin, and bilirubin levels may be indicated.

For patients with neuromuscular disorders, electrophysiological tests, evaluation of antibodies against acetylcholine receptors, cerebrospinal fluid examination, and imaging of the brain and spinal cord may be necessary. This stepwise approach helps to avoid unnecessary testing all at once, thereby ensuring a more focused and efficient diagnostic process.

In the emergency setting, the priority is to optimize oxygen saturation, determine the need for ventilation, and promptly diagnose and initiate appropriate treatment. As treatments for dyspnea are specific to the underlying disease, the treatment strategy will vary depending on the effectiveness of the interventions targeting the patient's dyspnea.

For bronchial asthma, treatment typically involves the use of bronchodilator inhalers, beta-agonists, steroids (administered orally, parenterally, or via inhalation), nebulizers, and avoidance of allergen exposure. Patients with COPD who experience persistent breathlessness despite optimal pharmacological therapy may benefit from exercise training and ambulatory oxygen supplementation.[24] The application of a fan or cool air to the face can produce a facial cooling effect, which stimulates mechanoreceptors and reduces dyspnea perception.[25] In cases of massive bullae (>1/3rd of hemithorax), bullectomy may be performed, while severe hyperinflation due to emphysema may necessitate volume reduction surgery to improve ventilatory muscle performance.[26]

For pneumonia, particularly in elderly patients, appropriate empirical intravenous antibiotics and supplemental oxygen therapy via nasal cannula, non-rebreather or bag-valve mask are recommended. In tuberculosis or coronavirus disease, appropriate therapy along with infection control measures is essential. Patients with pneumothorax or pleural effusion may require immediate needle decompression followed by tube or catheter thoracostomy. Patients experiencing dyspnea due to ascites secondary to malignancy or liver disease may find relief through large-volume paracentesis.

For patients experiencing mild shortness of breath with normal oxygen saturation at room air, 2 liters per minute of oxygen via nasal cannula is typically adequate. In hypoxic patients exhibiting evident breathing difficulties, oxygen supplementation at a rate of 5 liters per minute via mask should be administered, with a target oxygen saturation range of 94 to 98 percent. High-flow nasal oxygen therapy offers several advantages, including reduced nasopharyngeal resistance, elimination of dead space, and enhanced oxygen delivery.[27]

In severe cases of inadequate gas exchange, non-invasive positive pressure ventilation (NIV) may be necessary. NIV not only improves gas exchange but also alleviates the work of breathing, reduces respiratory rate and dyspnea, lowers left ventricular afterload by reducing intrathoracic blood volume, and enhances cardiac output.[28] Continuous positive airway pressure (CPAP) is beneficial for those with acute bronchoconstriction and during the weaning process from mechanical ventilation. It should be carefully adjusted to maximize subjective benefit. If NIV proves ineffective and ventilatory support is required, endotracheal intubation becomes necessary. In cases of hypoxemic respiratory failure unresponsive to mechanical ventilation, extracorporeal membrane oxygenation (ECMO) may be warranted.

In cases of coronary heart disease, treatment typically involves the administration of aspirin, antiplatelet agents, anticoagulants, as well as angiography and angioplasty interventions. In congestive heart failure resulting from valvular disease, valve replacement is often necessary, alongside diuretics, nitrates, and supplemental oxygen during acute presentations. Intravenous fluids and vasopressors may be administered to improve right ventricular filling pressures, while diuretics are indicated if volume overload is suspected. Emergency pericardiocentesis is beneficial for patients with pericardial effusion and cardiac tamponade.

For patients with anemia, interventions include stopping blood loss, and supplementing iron, folic acid, vitamin B12, and packed red blood cell transfusions if hemoglobin levels

fall below 7 g/dL. It's noteworthy that in cardiopulmonary healthy individuals with normovolemia, irreversible organ damage due to hypoxia occurs when hemoglobin levels drop below 5 g/dL.[18] Patients with methemoglobinemia do not respond to supplemental oxygen and require treatment with methylene blue.

In patients experiencing upper airway obstruction, it is advisable to prioritize maintaining the airway through early interventions such as intubation, cricothyrotomy, or tracheostomy, depending on the expected clinical course, before addressing the underlying cause. However, in cases of foreign body obstruction, immediate removal via methods such as chest blows, abdominal thrusts, direct laryngoscopy, or bronchoscopy is undertaken as a curative measure.

For conditions like retropharyngeal or parapharyngeal abscess, and epiglottitis, broad-spectrum intravenous antibiotics are administered, followed by appropriate incision and drainage of the abscess. Bilateral abductor cord paralysis may necessitate emergency tracheostomy, followed by corrective treatment such as cord lateralization. Similarly, in cases of laryngeal or pharyngeal growths, emergency tracheostomy is performed, with curative surgery or chemo-radiotherapy provided subsequently.

During anaphylaxis, the administration of beta-2 adrenergic agonists, antihistamines, and steroids proves beneficial. In cases of cardiac tamponade, pericardiocentesis is indicated, while pulmonary embolism often requires treatment with anticoagulation, lytic agents, and thrombectomy. Needle decompression and tube thoracostomy are standard procedures for managing pneumothorax, and metabolic acidosis is typically addressed with insulin therapy and intravenous electrolyte supplementation.

In the emergency department, psychogenic causes of dyspnea are diagnosed through exclusion after ruling out organic causes. Patients experiencing psychogenic hyperventilation may find relief by breathing into a bag. Education about negative organic findings is beneficial, particularly in individuals with a history of multiple panic attacks. Additionally, benzodiazepines, such as alprazolam, and psychotherapeutic interventions are helpful in managing psychogenic dyspnea.

In terminally ill cancer patients, dyspnea can result from a variety of factors including cachexia, weakness of respiratory muscles, fear, loneliness, tension, and depression. Symptom relief can often be achieved through information and counseling regarding the underlying causes and potential palliative options. Refractory dyspnea in these patients may respond to opioids, which have both anxiolytic effects and improve respiratory effectiveness by reducing dead space ventilation.[18]

Upon discharge, it is crucial to inform patients of their diagnosis, provide guidance on how to manage worsening symptoms, and outline any further tests or follow-up appointments required on an outpatient basis.

3. Conclusion

Dyspnea can stem from various causes beyond the typical heart and lung conditions. Its lack of specificity poses a clinical challenge in swiftly and accurately identifying the underlying factors. Upon generating clinical suspicion through history and examination, confirmation or refutation can be achieved through the utilization of biomarkers and imaging. By pursuing these findings, the spectrum of potential differential diagnoses significantly expands, facilitating targeted therapy in numerous cases.

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None.

5. Conflict of Interest

None.

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