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Pharmacotherapeutic approaches to acute chest conditions: Insights from emergency medicine and pharmacy for general practitioners

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Abstract

Acute chest pain is the primary symptom for several life-threatening diseases that require instant intervention. A correct diagnosis is often delayed and clinical uncertainty is widespread, and mortality rates continue to be high among adults and children with acute chest conditions, such as pulmonary embolism (PE) and acute chest syndrome (ACS). This systematic review emphasizes the significance of pharmacotherapeutic approaches for general practitioners in diagnosing, managing and treating acute chest conditions. Pharmacotherapeutic approaches can be employed by general practitioners to enhance patients' quality of life, improve pain diagnosis and management, and reduce mortality and hospitalization through using cues from the patient's clinical history, physical examination, and diagnostic testing (ECG and CXR) in their initial assessment to complete optimal pharmacotherapeutic interventions.

Keywords: Pharmacotherapy, Acute Chest Conditions, Emergency Medicine, Pain Diagnosis and Management, Intervention.

Introduction

Acute chest pain is the primary symptom for many life-threatening diseases that require immediate intervention and supportive care; including myocardial infarction/uneven angina, pneumothorax, pericarditis, dissecting aortic aneurysm, pneumonia, pulmonary embolism, and acute chest syndrome (Bosma et al., 2010). In order to evaluate a patient with the complaint of acute chest pain, the general practitioner has to be familiar with differential pharmacotherapeutic approaches to acute chest conditions in order to reduce rates of morbidity, hospitalizations and death in children and adults (Guttikonda and Vadapalli, 2018).

Furthermore, symptoms of acute chest conditions, including difficulty in breathing, are the most common complaint presented in adults. Additionally, cough, fever, hypoxemia, tachypnea, or abdominal pains are common complaints presented for children (Devos and Jacobson, 2016). Pharmacotherapeutic approaches in these cases are to rule out infections and get proper blood cultures as well as serologic studies. Radiographic evidence (such as: X-ray) of pulmonary infiltrates may be conducted at the early time of symptoms. Besides, stomach ulcer, rib infarction, or gallbladder issues can result in acute chest pain that should be checked in a correct manner (Amaechi et al., 2021).

Moreover, acute chest syndrome (ACS) is defined as a severe lung-related complication of sickle cell disease, which has an effect on both adults and children (Marlowe and Geiler, 2012). ACS results in a pulmonary infarction/emboli or viral or bacterial pneumonia, which is a leading cause of morbidity, hospitalization and death (Meloy et al., 2023). Pharmacotherapeutic approaches for managing acute chest syndrome includes antibiotics, oxygen, judicious analgesia, hydration with IV crystalloid solutions, and transfusion, particularly in severe cases (Tawfik et al., 2019).

Likewise, acute respiratory distress syndrome (ARDS) is a life-threatening condition that is characterized by poor oxygenation and leakage of fluids in the lung (Bellani et al., 2016). On one occasion ARDS develops, patients typically have various degrees of pulmonary artery vasoconstriction and may possibly develop pulmonary hypertension (Telen, 2017). Critical care approaches are employed to support patients with ARDS, including strategies for mechanical ventilation, which have resulted in improved results in the last decade. Nevertheless, there is an urgent need for effective pharmacotherapeutic approaches to diagnose, manage and treat acute chest conditions, such as patients with ARDS, as mortality rates continue to be high (Bosma et al., 2010). Up to now, no particular pharmacotherapy has demonstrated an effective approach in reducing mortality in adult patients with ARDS (Guttikonda and Vadapalli, 2018).

Similarly, pharmacotherapeutic approaches to diagnose and manage patients presenting with acute chest condition (such as: acute dyspnea) is considered as a major challenge for general practitioners in emergency departments that requires complex decision-making in order to realize hemodynamic balance, enforce functional capacity, and reduce mortality

and hospitalization (Amaechi et al., 2021). A correct diagnosis is often delayed and not easy to make certain, and clinical uncertainty is widespread, highlighting the need for fast diagnosis and a timely management plan. Accordingly, the aim of this systematic review is to highlight how pharmacotherapeutic approaches are employed to conduct rapid diagnosis and accurate management can be lifesaving for patients with acute chest conditions.

Methodology

The research method used in this review paper is a systematic review with a high level of evidence, which is conducted to identify pharmacotherapeutic approaches to acute chest conditions for general practitioners from the perspective of emergency medicine and pharmacy. This systematic review is a comprehensive protocol-driven review and synthesis of data to provide general practitioners with feasible solutions for diagnosing and managing patients presenting with a potentially life-threatening acute chest condition based on evidence from emergency medicine and pharmacy.

A variety of studies are identified while searching in MEDLINE, PubMed, PsycINFO, LILACS, and EMBASE databases starting from 2010 to 2023. Search terms used for this review paper are "pharmacotherapeutic approaches", "acute chest conditions", "emergency medicine", and "pharmacy". Furthermore, reference lists of related articles are manually reviewed to extract further studies that serve the purpose of this evidence-based systematic review.

This systematic review is a collaborative activity of experienced individuals related to the health sector in Saudi Arabia, who have developed a protocol for selection of the studies meeting the inclusion criteria, critical evaluation of the studies, and synthesis and interpretation of the results (Tawfik et al., 2019). The inclusion criteria specified for this systematic review are selection of original studies manipulating pharmacotherapeutic approaches to acute chest conditions for general practitioners from the perception of emergency medicine and pharmacy. Studies are included irrespective of language and date of publication. The exclusion criteria specified for this systematic review are non-peer reviewed papers, reviews, editorials, guidelines and case reports or studies not focusing on acute chest conditions.

Data extraction is conducted to collect relevant pieces of information from the studies that are assessed for eligibility, including research methodology for systematic reviews, pharmacotherapeutic approaches, timely intervention and management, and findings. In addition, quality assessment for included studies is performed using standardized tools that are apt for respective study designs. Moreover, a narrative synthesis of results extracted from the included studies is performed to draw conclusions.

Literature Review

Literature is extensively searched and reviewed to highlight pharmacotherapeutic approaches to acute chest conditions from the perspective of emergency medicine and pharmacy for general practitioners. A variety of studies are identified while searching in

MEDLINE, PubMed, PsycINFO, LILACS, and EMBASE databases. Search terms used for this review paper are "pharmacotherapeutic approaches", "acute chest conditions", "emergency medicine", "pharmacy", "diagnosis", "management", and "intervention". Furthermore, reference lists of related articles are manually reviewed to extract further studies that serve the purpose of this evidence-based systematic review.

Furthermore, the inclusion criteria specified for this systematic review are selection of original studies manipulating pharmacotherapeutic approaches to acute chest conditions for general practitioners from the perception of emergency medicine and pharmacy. Studies are included irrespective of language and date of publication. The exclusion criteria specified for this systematic review are non-peer reviewed papers, reviews, editorials, guidelines and case reports or studies not focusing on acute chest conditions.

Additionally, a number of 29 studies have met the eligibility criteria. Study designs have included randomized controlled trials and cohort studies. Key intervention components examined are patient education, disease diagnosis and management, pharmacotherapeutic approaches, follow-up consultations, and multi-disciplinary case management. Findings assessed are clinical parameters, supportive care, quality of life, and overheads.

Preliminary findings signify that pharmacists and physicians as part of the multidisciplinary healthcare team help in optimizing pain diagnosis and management through employing pharmacotherapeutic approaches to acute chest condition. Consequently, this can enhance patients' quality of life, improve pain diagnosis and management, and reduce pain intensity. However, limitations in study quality and heterogeneity need to further research.

Discussion

General practitioners can play a vital role in optimizing proper pharmacotherapeutic approaches to acute chest conditions. General practitioners as part of the multidisciplinary healthcare team can help in optimizing pain management, enhancing the patients' quality of life, providing clinical recommendation, and improving pain diagnosis and management (Herlitz et al., 2011). According to Amaechi et al. (2021), a basic pharmacotherapeutic approach to acute chest conditions has to embrace the ability to recognize pain, assess its type and provide appropriate treatment.

For such patients with acute chest conditions, the initial assessment engages taking a patient’s clinical history, conducting physical examination, getting diagnostic testing (e.g.; ECG and chest radiograph), and pharmacotherapeutic interventions.

Clinical History

The patient's clinical history is significant in evaluating patients with acute chest conditions but it can be hard to get if the patient has difficulty in speaking. However, the general practitioner focuses mostly on keeping adequate oxygenation and ventilation for the patient. Relevant clinical history can be attained from the patient, family and friends, pharmacists, and emergency medical services providers.

The assessment of the general practitioner has to start with a clinical history elaborating the features of the patient's pain, including its quality, position, and radiation, duration of symptoms, and any related symptoms, chiefly whether pulmonary or gastrointestinal (Telen, 2017). For example, ACS is generally illustrated as a diffuse substernal chest pressure, which begins gradually, radiates to the arms or the jaw, and it gets worse by exertion and relieved by rest or nitroglycerin (Pham, 2013). Studies have suggested that response to nitroglycerin may not constantly differentiate cardiac chest pain from noncardiac chest pain (Guttikonda and Vadapalli, 2018). In contrast to the tempo of the chest pain in ACS, pulmonary embolism, aortic dissection, and pneumothorax all present with chest pain that is sudden and severe in onset. Moreover, pain that is pleuritic or positional suggests pneumonia, pericarditis, pulmonary embolism, or a musculoskeletal condition (Bellani et al., 2016).

Physical Examination

The general practitioner conducts a comprehensive physical examination of patients with acute chest conditions after the initial rapid screen and any necessary stabilization. This procedure can help in identifying potential causes of myocardial ischemia, important co-morbid conditions, and evidence of hemodynamic complications (Herlitz et al., 2011). Besides vital signs, examination of peripheral vessels should include assessment of the presence of bruits or absent pulses that suggest extra cardiac vascular disease (Pham, 2013).

If patients' physical examination does not suggest myocardial ischemia, the general practitioner should examine non-coronary causes of chest pain, which are potentially life-threatening issues; such as pulmonary embolism and aortic dissection (Boucher, 2010). Subsequently, the general practitioner turns to the likelihood of other cardiac diagnoses such as pericarditis and non-cardiac diagnoses such as esophageal discomfort (See Table 1). In addition, aortic dissection is suggested by pulse disparities, blood pressure or by a new murmur of aortic regurgitation along with back or midline anterior chest pain (Han and Martinez, 2011). Various studies suggest that differences in breath sounds accompanied with pleuritic chest pain and acute dyspnea increase the likelihood of tachycardia, pneumothorax, tachypnea, and pulmonary embolism on physical examination (Pham, 2013; Devos and Jacobson, 2016; Amaechi et al., 2021).

Diagnostic Testing

Diagnostic testing is to be conducted in the perspective of clinical history and physical examination findings. Moreover, random testing with no clear differential diagnosis can

mislead the general practitioner and delay proper pain management (Guttikonda and Vadapalli, 2018). Patients presented to emergency departments with acute chest conditions can conduct a plain chest radiograph (CXR), an electrocardiogram (ECG), and laboratory tests (See Table 1). Bedside, ultrasound is a valuable diagnostic instrument for investigating critical causes of acute chest conditions but it requires equipment and operator proficiency (Meloy et al., 2023).

Han and Martinez (2011) state that ECG is a critical source of data for both pain diagnosis and prognosis. ECG has to be obtained as quickly as possible after presentation in patients with acute chest condition. ECG is a critical device that assists in improving diagnostic accuracy and decreases the admission rate (Boucher, 2010). ECG can improve the general practitioner's ability to diagnose and manage different acute chest conditions.

Furthermore, CXR is usually obtained in all patients presenting with acute chest conditions. It is a nondiagnostic in patients with ACS, but it can illustrate pulmonary edema caused by ischemia-induced diastolic or systolic dysfunction (Guttikonda and Vadapalli, 2018). CXR is useful for diagnosing or suggesting other disorders; as it may demonstrate an enlarged mediastinum or aortic knob in aortic dissection (Devos and Jacobson, 2016). CXR is usually normal in pulmonary embolism, but it can show atelectasis, an elevated hemidiaphragm, a pleural effusion, Westermark's sign or Hampton's hump (Tawfik et al., 2019). CXR can reveal pneumonia or pneumothorax (Amaechi et al., 2021).

In most cases related to acute chest conditions, the general practitioner can establish the patient's diagnosis based upon a detailed clinical history, physical examination, and diagnostic testing; including CXR and ECG. Signs associated with acute chest conditions, their clinical significance, and possible diagnoses are detailed below in Table (1). If required, extra testing is directed based on suspicion for disease processes.

Table (1): Signs of Acute Chest Conditions

Physical examination finding	**Clinical significance**	**Possible diagnosis**
Absent/reduced breath sounds	Decreased air movement	Severe asthma Pneumothorax Hemothorax COPD Tension pneumothorax
Accessory muscle use	Muscle weakness, fatigue	Severe COPD Respiratory failure Severe asthma
Expiratory/mixed stridor	Air flow obstruction below vocal cords	Foreign body Croup Bacterial tracheitis

Inspiratory stridor	Air flow obstruction above vocal cords	Angioedema Epiglottitis Foreign body
Hyperventilation		Anxiety Acidosis Salicylate poisoning Sepsis
JVD with clear lungs	Right heart failure	Pulmonary embolism Cardiac tamponade
JVD with crackles	Right and left heart failure	ARDS ADHF
Heart murmur	Valvular disease	Valvular dysfunction
Hepatojugular reflux	Right heart failure	ADHF
Pulsus paradoxus	Poor right heart filling	Cardiogenic shock Pulmonary embolism Asthma exacerbation Pericardial tamponade Right heart failure
Crackles (Rales)	Interalveolar fluid	Pneumonia ARDS ADHF
Wheezes	Obstruction below trachea	Foreign body COPD ADHF Asthma exacerbation

Intervention using pharmacotherapeutic approaches

Pharmacotherapy is defined as a medical treatment that uses pharmaceutical drugs to improve current symptoms, treat the causal condition, or prevent other diseases (Bosma et al., 2010). Pharmacotherapeutics has developed from a long history of medication use, and advances in drug industry have changed pharmacotherapy most quickly in the last century (Telen, 2017). This type of therapy is managed and adjusted by healthcare professionals according to the evidence-based guidelines and the patient's health condition (Boucher, 2010). Pharmacotherapy can be differentiated from surgical therapy, radiation therapy, physical therapy, or other modes of therapies.

Furthermore, the main concerns facing the general practitioner in emergency departments when patients presented with acute chest conditions are to optimize arterial oxygenation

and decide the need for emergency airway management and ventilatory support (Bellani et al., 2016). Additionally, the general practitioner should be familiar with pharmacotherapeutic approaches to acute chest conditions in order to recognize whether a life-threatening condition exists; such as trauma, asthma, pulmonary embolism, arrhythmia, acute coronary syndrome, anaphylaxis, pericardial tamponade, acute heart failure, angioedema, pneumonia, chronic obstructive pulmonary disease (COPD) exacerbation, and to initiate treatment and stabilization (Amaechi et al., 2021).

On the other hand, the general practitioner may face some potential pitfalls in diagnosing and managing patients presented with acute chest conditions. A study conducted by Meloy et al. (2023) indicates that lack of familiarity with various pharmacotherapeutic approaches by the general practitioner may lead to fail in securing the airway in a timely manner and fail in recognizing and acting on abnormal vital signs and signs of impending respiratory failure. Besides, over-reliance upon a single result while conducting physical examination or a result of a diagnostic test may lead to fail in generating an apt differential diagnosis (Guttikonda and Vadapalli, 2018). Also, the general practitioner may fail in monitoring the patient's clinical course or fail in diagnosing carbon monoxide poisoning, methemoglobinemia, or pulmonary embolism (Tawfik et al., 2019). The general practitioner may misinterpret tachypnea, which may indicate to nonpulmonary disease; such as metabolic acidosis (Amaechi et al., 2021). The general practitioner may misapprehend the diagnosis allowing patients with acute chest conditions to leave the Emergency department with insufficient follow-up or imprecise instructions (Bellani et al., 2016).

Conclusion

Acute chest conditions are the major causes for admission to the emergency department. Although accurate and fast diagnosis and management can be lifesaving for patients with acute chest conditions, it is a clinical challenge for the general practitioner to stand on a differential diagnosis that requires complex decision-making. A correct diagnosis is often delayed and not easy to make certain, and clinical uncertainty is widespread, highlighting the need for effective pharmacotherapeutic approaches as mortality rates continue to be high among adults and children. Up to now, no particular pharmacotherapy has demonstrated an effective approach in reducing mortality.

Effective pharmacotherapeutic approaches in diagnosing and managing cases of acute chest conditions have great potentials to accomplish hemodynamic balance, enforce functional capacity, and reduce mortality and hospitalization. Likewise, basic pharmacotherapeutic approaches to acute chest conditions have to embrace the ability to recognize pain, assess its type and provide appropriate treatment. Using cues from the patient’s clinical history and physical examination, general practitioners may manage effective pharmacotherapeutic approaches to acute chest conditions. Additionally, early use of diagnostic testing, including ECG and CXR, may limit needless tests and save time in deciding the optimal treatment course.

References

Amaechi O, Huffman MM, Featherstone K. Pharmacologic Therapy for Acute Pain. Am Fam Physician. 2021 Jul 1;104(1):63-72. PMID: 34264611.

Bellani G, Laffey JG, Pham T, Fan E, Brochard L, Esteban A, Gattinoni L, van Haren F, Larsson A, McAuley DF, Ranieri M, Rubenfeld G, Thompson BT, Wrigge H, Slutsky AS, Pesenti A. Epidemiology, patterns of care, and mortality for patients with acute respiratory distress syndrome in Intensive Care Units in 50 Countries. JAMA. 2016; 315:788. doi: 10.1001/jama.2016.0291.

Bosma KJ, Taneja R, Lewis JF. Pharmacotherapy for prevention and treatment of acute respiratory distress syndrome: current and experimental approaches. Drugs. 2010 Jul 9;70(10):1255-82. doi: 10.2165/10898570-000000000-00000. PMID: 20568833; PMCID: PMC7100688.

Boucher B. Formulary decisions: then and now. Pharmacotherapy. 2010; 30:35S-41S.

Devos E, Jacobson L. Approach to Adult Patients with Acute Dyspnea. Emerg Med Clin North Am. 2016 Feb;34(1):129-49. doi: 10.1016/j.emc.2015.08.008. PMID: 26614245; PMCID: PMC7126145.

Guttikonda, S.N.R., Vadapalli, K. Approach to undifferentiated dyspnea in emergency department: aids in rapid clinical decision-making. Int J Emerg Med 11, 21 (2018). https://doi.org/10.1186/s12245-018-0181-z

Han MK, Martinez FJ. Pharmacotherapeutic approaches to preventing acute exacerbations of chronic obstructive pulmonary disease. Proc Am Thorac Soc. 2011 Aug;8(4):356-62. doi: 10.1513/pats.201102-016RM. PMID: 21816992.

Herlitz J, Bång A, Omerovic E, Wireklint-Sundström B. Is pre-hospital treatment of chest pain optimal in acute coronary syndrome? The relief of both pain and anxiety is needed. Int J Cardiol. 2011; 149:147–151.

Marlowe KF ,Geiler R. Pharmacist's role in dispensing opioids for acute and chronic pain. J Pharm Pract 2012; 255:497–502

Meloy P, Rutz DR, Bhambri A. Acute Chest Syndrome. J Educ Teach Emerg Med. 2023 Jan 31;8(1):O1-O23. doi: 10.21980/J80S8J. PMID: 37465032; PMCID: PMC10332774.

Pham T. Pharmacology and Therapeutics of Pain Medications: Part 1. Drug Topics. 2013; P: 42-54.

Tawfik, G.M., Dila, K.A.S., Mohamed, M.Y.F. et al. A step by step guide for conducting a systematic review and meta-analysis with simulation data. Trop Med Health 47, 46 (2019). https://doi.org/10.1186/s41182-019-0165-6

Telen MJ. Developing new pharmacotherapeutic approaches to treating sickle-cell disease. ISBT Sci Ser. 2017 Feb;12(1):239-247. doi: 10.1111/voxs.12305. Epub 2016 Nov 15. PMID: 28484512; PMCID: PMC5418585.