IN BRIEF A Summary of the Evidence

Optimal Strategies to Diagnose Acute Pulmonary Embolism

Key Messages

- The first step to diagnosing acute pulmonary embolism (PE) is to use a clinical prediction rule that helps to assess the likelihood of PE. The two-tiered Wells rule is recommended.

- Depending on the results, additional testing and diagnostic imaging may be appropriate.

- The approach to diagnosing PE in the general population differs from the approach for pregnant patients and those who are not able to undergo specific tests.

Context

Acute pulmonary embolism (PE) occurs when a blood clot, usually originating from the leg, lodges in the blood vessels of the lungs. This can obstruct blood flow, which can lead to severe cardiovascular problems (e.g., increased blood pressure, heart strain, low blood oxygen levels). PE is a major cause of emergency hospitalization and, if left untreated, can be fatal in up to 30% of patients. People with acute PE may have a range of symptoms, such as chest pain, shortness of breath, and feeling faint, or no symptoms at all. Because the symptoms can be caused by a number of different conditions, PE can be hard to diagnose. Risk factors for PE include pregnancy, prolonged periods of being immobile, recent surgery, the use of the birth control pill and other hormone replacement therapies, and certain diseases (e.g., factor V Leiden mutation or other thrombophilia conditions). However, some people who experience PE may have no risk factors. PE is treated with anticoagulation therapy (medication that helps prevent blood clots), which, if given soon after a PE develops, can help reduce complications and death caused by recurrent PE.

Technology

The approach to diagnosing acute PE typically requires multiple steps. There may be an initial assessment to determine the likelihood that a person has PE. If appropriate, a person with suspected PE may undergo a series of additional tests, including diagnostic imaging.

Risk Stratification

Tests to help assess the likelihood of a patient having PE are often referred to as clinical prediction rules (CPRs); these provide a set of clinical criteria that can help determine if more testing is needed. Examples of CPRs

include the Wells rule, the Geneva score, and the revised Geneva score. Patients assessed to have a high probability of PE may proceed directly to diagnostic imaging, while patients with low probability may undergo more testing. These additional tests include Pulmonary Embolism Rule-Out Criteria, also known as PERC, or D-dimer testing (a lab test that looks for indications that a patient has a blood clot). The results of these tests may determine whether a patient needs confirmation testing or whether it is unlikely that they have a PE and do not require any further testing. For example, a negative D-dimer test in a low-risk patient (determined by applying a CPR) may rule out PE; while a positive D-dimer test may mean a patient goes on to have diagnostic imaging. However, if a patient is at high risk for PE, based on their CPR assessment, they may go directly to have diagnostic imaging without undergoing other tests like PERC or D-dimer.

Diagnostic Imaging

When patients have been assessed to be at high risk for PE, if they are very unwell; or if they have inconclusive results from D-dimer or PERC, they may need to undergo diagnostic imaging to confirm a possible PE. Examples of diagnostic imaging exams include computed tomography pulmonary angiography (CTPA), and ventilation/perfusion single-photon emission computed tomography (VQ-SPECT). CTPA uses X-rays and computer analysis to visualize the arteries of the lung. VQ-SPECT uses radioactive tracers and special cameras to detect a blood clot in the lungs by looking for a mismatch between air flow and blood flow. It is desirable to minimize radiation exposure for all patients but particularly in pregnant patients, young people, and people who undergo repeated scans (e.g., cancer patients), and some patients may be allergic to the contrast agents used in CT.

Issue

PE can be difficult to diagnose and determining the best strategy for diagnosis is controversial. The approach to diagnosis may also differ based on the resources available, especially depending on the setting (e.g., rural, remote, or urban). The use of diagnostic imaging without the use of CPR or other testing may have a low diagnostic yield; meaning that, of the patients who are evaluated for suspected PE, many do not actually have the condition (i.e., false-positive result). This can lead to unnecessary testing and treatment for patients, in addition to being costly, and there is a danger to being treated when a patient may not actually have a PE. Anticoagulation therapy can cause bleeding, interactions with other medications, and be a burden to patients who have to undergo repeated blood tests and who may have to pay out-of-pocket for medication. There is also potential harm in false-negative results (when a person with PE does not get diagnosed correctly) when testing for suspected PE, as recurrent PE can be fatal. The goal should be to diagnose suspected PE in a timely manner, using appropriate tests.

Methods

CADTH conducted a health technology assessment of the diagnostic test accuracy, clinical utility, safety, cost-effectiveness, patient experiences and perspectives, implementation issues, ethical issues, and environmental impact of approaches for the diagnosis of adults with suspected PE. The Health Technology Expert Review Panel developed recommendations on the optimal strategy to diagnosing PE based on the evidence presented in the HTA report.

Results

Clinical Review

A review of risk stratification rules found that the Wells rule was better able to correctly identify patients who did not have a PE compared with the Geneva score or the revised Geneva score. When it comes to correctly identifying patients who have a PE, no rule showed a consistent advantage over the others. A review of the evidence on diagnostic imaging found that CTPA was best able to correctly identify patients with a PE; however, alternative strategies may be considered where there is a heightened concern about radiation exposure (e.g., in pregnancy).

Economic Review

An approach using CPRs followed by CTPA (if appropriate) was found to be cost-effective. Specifically, the strategy of the two-tiered Wells rule, followed by D-dimer (for those with a low-risk to moderate-risk Wells), and then followed by CTPA (if appropriate), was cost-effective if the willingness-to-pay was between $13,556 and $57,097 per quality-adjusted life-year (a measure of the value for money of medical procedures and interventions). For patients who are not able to undergo CT or who wish to avoid CT, inclusion of VQ-SPECT and leg ultrasound in the diagnostic pathway was found to be cost-effective.

Patient Experiences and Perspectives

Findings from the patient review were focused mainly on diagnostic imaging. While these tests may be uncomfortable to undergo, the ability of the tests to shed light on current or prospective health problems was helpful to some patients. However, some patients described the experience of testing in terms of feeling isolated and unprepared, and lacking self-control. Physical reminders that patients are not alone (e.g., the presence of loved ones in the room, if possible) may help with these feelings.

Implementation Issues

Provider knowledge and choice (e.g., the use of tests most familiar to them) may influence the initial assessment and investigation of suspected PE. Additionally, patient factors — such as age, gender, and other illnesses — may influence the diagnosis of suspected PE. Policies and protocols (e.g., documented use of a CPR before additional testing) can be used to support the diagnostic strategies for PE. It is important to note that resources, including staffing, and access to tests, scans, and imaging, are differentially located across the country.

Ethical Issues

Clinicians, health care organizations, and policy-makers must consider the views and interests of those involved in PE diagnosis and the variation in individual patient needs. Based on the clinical and economic evidence, the use of CTPA appears to be the most favourable diagnostic imaging tool for an ethical approach to PE diagnosis, unless patients cannot undergo CTPA.

Environmental Issues

No relevant studies or reports were found that evaluated the environmental impact of imaging modalities for PE (based on a limited literature search).

Read more about CADTH and its review of Optimal Strategies to Diagnose Acute Pulmonary Embolism:

cadth.ca/optimal-strategies-diagnosis-acute-pulmonary-embolism.

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