Pulmonary embolism in a developing country: A review

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Citation

Abstract

Mortality associated with pulmonary embolism can be reduced significantly by timely diagnosis, leading to early and prompt treatment. History and physical examination findings are often nonspecific in patients with pulmonary embolism , but in developing country ,there are most reliable in diagnosis complemented with Well's score with having limited diagnostic avenues available to cater high patient load at tertiary hospital level . A high dependence on these factors is highly valuable in developing countries in diagnosis of pulmonary embolism. The review has been written to remind and highlight the importance of clinical history and signs supplemented with Well's score in diagnosis of the pulmonary embolism in tertiary care level handling excess patient load than its capacity and financial constraints of middle class patient limiting access for undergoing modern radiological investigations for diagnosis of pulmonary embolism.

INTRODUCTION

Pulmonary embolism is blockage of pulmonary artery or one of its branches by a blood clot, fat, air, amniotic fluid, injected embolism or clumped tumor cells.The primary diagnosis is a clinical suspicion. Most common form of pulmonary embolism is pulmonary thromboembolism [1] .Pulmonary thromboembolism is an acute silent killer in developing countries where clinician has to rely on his precious judgement to poach this killer. Our experience shows that in pulmonary thromboembolism, patient has always some peculiar abnormal show suggestive of pulmonary embolism. Though it appears to occurs in presence of specific risk factors, presence of subtle and nonspecific findings and lack of sophisticative investigations, with high patient load excess of its capacity at tertiary hospital level leads to overlooked mortality in pulmonary thromboembolism in developing states. Patients with pulmonary embolism who survive long enough to have the diagnosis established and appropriate prophylactic therapy begun have an excellent prognosis, unless they have associated severe medical disease [2] .The incidence of pulmonary thromboembolism is hard to assess by the pathologist as a result of seasonal variation of embolism and disappearance of emboli by thrombolysis [3]

Pulmonary embolism is confirmed ante mortem in only approximately 30 % of patients with remaining 2/3rds are diagnosed by autopsy illustrating difficulty in establishing correct diagnosis continues to be a major diagnostic dilemma for the clinician. One of the commonest non diagnosed or misdiagnosed disease .This misery is further compounded by presence of heavy patient, financial constraints of patients to afford already over loaded access limited modern diagnostic investigative tools in developing country. Early and accurate diagnosis is extremely important as a range of effective therapeuatic options are available. Acute pulmonary thromboembolism is the third most common leading cause of death in hospital patients, thereby reducing the morbidity and mortality.A keen clinical sense, thorough clinical examination and economic utilization of available investigative tools well versed sound knowledge of pulmonary embolism and dedication can make to clinch the diagnosis, with Well's clinical prediction score proving boon and substitute to costly modern diagnostic tools in our experience. The difficulties in establishing an accurate diagnosis of pulmonary embolism represent a permanent challenge and deserve an extensive literature review [4] .75% patient's die within one hour of onset of symptoms of pulmonary embolism [5]

The clinical triad of dysponea, chest pain and hemoptysis is seen only in 20% [6] .Arterial blood gas analysis though helpful in management, lacks utility in pulmonary thromboembolism embolism. Full understanding of the natural history of pulmonary embolism is elusive at the present time because many basic facts are either uncertain or unknown [7]

Pulmonary embolism usually arise from thrombi originating from the deep venous system of lower extremity , may originate in pelvic , renal ,or upper extremity veins and right chamber of heart .More than 90% of pulmonary embolus originate from a deep vein thrombosis of leg. After travelling to lung , large thrombi lodge at the bifurcation of main pulmonary artery or the lobar branches and cause main pulmonary artery or the lobar branches block causing hemodynamic compromise Smaller thrombi continue traveling distally occluding a smaller vessel with < 20 % deep vein thrombus of lower leg and 20-30% of upper leg propagate into iliofemoral veins. Most emboli are multiple and lower lobes are more affected than the upper lobes. Distribution to both lungs of thrombi after release from venous thrombi in circulaton is 65%, right lung is 25%, and left lung is 10% .Most emboli lodge in large or intermediate arteries, 35% or less in smaller pulmonary arteries [8]

RISK FACTORS

Applying common sense makes risk factors for pulmonary embolism evident.Surgery and long term immobilization are regarded as highest risk factor for this entity [9] . A greater distance traveled is a significant contributing risk factor for pulmonary embolism associated with air travel [10]

CLINICAL PRESENTATION

Pulmonary embolism has variable range of presentation from minor symptoms to massive embolism. No single symptom has 100% accuracy. Manifestations in young and old may be variable. These vary from from no show, hemodynamic instability to respiratory dysfunction. It is not important to detect symptomatic pulmonary thromboembolism, clinical acumen lies in diagnosing asymptomatic pulmonary embolism, as this could be precursor of massive embolisation with a high mortality .No false positive diagnosis should be obtained as the treatment of pulmonary is anticoagulants, which are associated with multiple adverse effects and complications.

PULMONARY EMBOLISM CAN BE DIVIDED INTO

"Massive" and "Non-massive" :

Massive pulmonary is shock or hypotension <90mm Hg or a sustained fall in BP 40mmHg for >15 min, not caused by arrhythmia, hypovolaemia or sepsis. Non massive group is subdivided to identify patients with echocardiographic signs of Right ventricular hypokinesis which has a poorer prognosis.

PHYSICAL EXAMINATION

What a significant to be labeled as having pulmonary embolism is thorough and careful history and clinical examination. A sound knowledge of risk factors and clinical features with stress on each finding and careful analysis and work up with Well's prediction score can be near to avoid super added mobidity and mortality of surgery.This is the only precious avenue supplemented with available meager investigative tools which is utilized and to be used in judging pulmonary embolism in tertiary care level in developing states where there is more than excess of flow of patients in hospital than its capacity. Risk score interpretation of Well's clinical prediction score for pulmonary embolism and deep vein thrombosis is pivot on which predictors of pulmonary embolism is suspected. These are extraordinary resources in developing country for diagnosis of pulmonary embolism.To be have utilization of these precious gems .clinician should be vigilant and thorough with manifestations of pulmonary embolism and Well's clininical prediction score on tip of tongue.

INVESTIGATION MODALITY FOR PULMONARY EMBOILISM:

Routine Investigation

D-dimer assay

Conventional Chest X-ray

Electrocardiogram

Echocardiography

Ventilation Perfusion Scan(VPS)

Computer tomography Pulmonary angiography(CT-PA)

Magnetic resonance pulmonary angiography(MRA)

D- Dimer Assay

A unique degradation product produced by plasmin mediated proteolysis of cross linked fibrin measured by Latex agglutination test or by ELISA In population with 50% prevalence of pulmonary embolism Positive predictive value is 79%. Under best circumstances misses 10% of patients with positive pulmonary angiography .Levels of > 500 ng/ml is considered positive.The ELISA D -dimer test is highly sensitive but nonspecific for the detection of pulmonary in the clinical setting [11] .In combination with the Well's clinical prediction rule this is effective in ruling out

pulmonary embolism in the patient who presents to the emergency department. Negative D-dimer value is effective in ruling out pulmonary embolism in a low to moderate pretest probability of thrombus and non diagnostic ventilitation perfusion scan. In low to moderate suspicion of pulmonary embolism, a normal D-dimer is enough to exclude the possibility of pulmonary among clinically suspected cases of pulmonary embolism, fall in serum angiotensin convertase level can be used as a sensitive and reliable diagnostic marker as more than 75% of the enzyme is produced in the lungs compared with other enzymes which have extra-pulmonary source,may be positive in postoperative patients, and results can be misleading in patients with cancer [12,13]

CONVENTIONAL CHEST X-RAY

This is the commonest Investigation done. There are indirect signs which may suggest pulmonary embolism:

"Westermark Sign" Is focal area of regional oligemia.

"Fleischner Sign"is Central pulmonary arteries may be prominent'

"Hampton's Hump" Plueral based opacities representing infarcted or atelectic lung

-Right heart enlargement.

-Concimitant plueral effusion---Elevation of hemidiaphragm.

These are extremely nonspecific and only rarely can diagnosis be established on these findings .Among PIOPED patients with confirmed pulmonary embolism, atelectasis or parenchymal abnormalities were noted in 69%, compared with 58% of patients without pulmonary embolism. Significant hypoxemia with a normal or relatively normal chest x-ray film should raise the suspicion of pulmonary embolism. Other chest x-ray findings suggestive of pulmonary embolism include pulmonary artery enlargement, pleural effusion, and elevated hemidiaphragm [14] . In massive pulmonary embolism, a chest radiograph demonstrates some mortality in about 90%of patients. Common findings noted are cardiomegaly , pleural effusion and pulmonary artery enlargement [15]

Electrocardiogram (ECG)

The most common sign is sinus tachycardia. Signs of right heart strain and acute cor pulmonale in cases of large

pulmonary embolism.The classic sign on ECG is S-wave in lead 1,Q-wave in lead 3,and inverted T wave in lead 3 pattern. Occasionally presenting in 20% cases, but may occur in other lung conditions and has limited diagnostic value. Standard 12-lead ECG findings can increase the pretest probability of pulmonary embolism before performing CT pulmonary angiography; and that the ECG findings have relatively low likelihood ratios to have clinical use [16]

ECHOCARDIOGRAPHY

In massive pulmonary embolism, dysfunction of the right side of the heart can be seen . An indication that pulmonary artery is severely obstructed and the heart is unable to match the pressure In United States, this is an adequate indication for thrombolysis. Trans esophageal echocardiography is a rapid, practical, bedside test remains the primary imaging modality for pulmonary embolism diagnosis in the operating room. Transesophageal echocardiography is highly specific, but because of its low sensitivity in operative settings, its utility remains limited. Intraoperative contrast enhanced Transesophageal echocardiography may decrease operator dependency and increase the resolution necessary to detect central, surgically accessible pulmonary embolism. [17]

COMPRESSION ULTRASONOGRAPHY

A compression ultrasonogram that reveals lower-extremity deep vein thrombosis is considered indirect evidence of pulmonary embolism, and anticoagulant therapy should begin immediately. This color-flow Doppler ultrasound shows a vein with a noncompressible filling defect consistent with deep-vein thrombosis [18]

IMPEDANCE PLETHYSMOGRAPHY

This is highly sensitive and specific for deep vein thrombosis. Though less expensive (as a single test) than compression ultrasonography, however, it is also less specific. False-positive results are more common in patients with increased central vascular pressure as in vascular disease or congestive heart failure, and in those receiving mechanical ventilatory support.Because the legs must be kept bent and motionless for about two minutes, this procedure is uncomfortable for some patients

VENTILATION PERFUSION SCAN

This is frequently utilized test, are based on the demonstration of radioactive particles blocked in the pulmonary capillaries.

Tc-99 micro aggregated albumin particles are used.

6-8 views are taken

a)Anterior b)Posterior

c)Right Lateral d)Left lateral

e)Right Postero- oblique f)Left Postero-oblique

The scan has negative predictive value – 98%, highly sensitive but with low specificity.All positive scans needs to be validated by Chest X-rays 's and complemented with ventilation scans.Abnormal ventilation scans indicate abnormal nonventilated lung, thereby providing possible explanations for perfusion defects other than acute pulmonary embolism. A high probability scan for pulmonary embolism is defined as having two or more segmental perfusion defects in the presence of normal ventilation.Results are classified into five categories.

A) High Probability. B)Intermediate Probability.

C)Low Probability. D)Very low Probability E)Normal.

A High probability VPS provides sufficient evidence for the initiation of treatment of of pulmonary embolism.A normal scan should be considered sufficient to exclude pulmonary embolism.It is useful in patients who have allergy to iodinated contrasts or in pregnancy due to lower radiation exposure than to CT.

SPIRAL COMPUTED TOMOGRAPHY (CT) ANGIOGRAPHY

Introduction of spiral CT and CT angiography of the pulmonary arteries finally ended the search for a highly sensitive and accurate test to detect pulmonary artery thromboembolism.With CT angiography it is possible to depict endoluminal thrombi in central as well as second to fourth division of pulmonary artery .Spiral CT angiography of pulmonary arteries is performed from the apices to the base of the lungs.50 cc. of nonionic intravenous contrast is injected at a flow rate of 3-4 ml./ sec.with a scan delay of 20-25 sec. The findings observed are:

Pulmonary infarcts appear well defined wedge shaped sub pleural parenchymal consolidation with apex pointing to the pulmonary artery, base along the pleural surface.

Ocassionaly cavitation may be seen in consoliditation.

Presence of atelectasis and effusion (nonspecific findings)

Spiral CT has added advantage of determining the age of thrombus as well as demonstrating other pathologies which simulate pulmonary thromboembolism such as pneumonia, pneumothorax,and aortic dissection.Sensitivity of CT angiography for pulmonary thromboembolism is 90% comparable to the sensitivity of pulmonary angiography.There are limitationsIn the evaluation of arteries below the segmental level due to the small vessel diameter there is limited spatial resolution ,insufficient enhancement and spatial orientation of vessels and thrombi.Diagnostic studies give conflicting results for the diagnostic accuracy of CT pulmonary angiography. Follow up studies show that CT pulmonary angiography can be used in combination with investigation for deep vein thrombosis to exclude pulmonary embolism [19] .Pitfalls may be due to technical factors or anatomical factors. Technical factors may produce pseudofilling defects .These may be due to inappropriate selection of injection parameters ,flow rate concertation,scan delay or breath hold.Anatomical landmarks and variants especially intersegmental nodes causing filling defects.Care should be taken that filling defects are intravascular and not intersegmental nodes. Spiral CT and ventilaton –perfusion scans investigate totally different aspects of pulmonary embolism.Scintigraphy demonstrates thrombic vascular occlusion in central pulmonary arteries of the lung by lack of radioactivity distal to the occlusion.Spiral CT directly visualises thrombi in the central pulmonary artery.Usually central thromboemboli coexist with peripheral vascular thrombotic occlusions. Therefore both tests frequently lead to concordant positive and negative results.Discordant results may occur if there are central non occluding pulmonary thromboemboli only.In this case the spiral CT will be positve and the scintigraphic findings negative.

PULMONARY ANGIOGRAPHY

This is considered gold standard in evaluation of pulmonary thromboembolism Selective catheritisation of right and left pulmonary arteries is done. Images are obtained by two views usually on digital subtraction angiography machine Acute pulmonary thromboembolism is demonstrated as intraluminal filling defect or wedge shaped perfusion defect due to occlusion of pulmonary vessels Cine angiography, Balloon angiography and Superselective angiography are available for detection of small pulmonary emboli. Emergency pulmonary angiography is a feasible, safe, highly sensitive diagnostic tool in acute pulmonary embolism before starting intrapulmonary or systemic thrombolytic therapy with its potential hazards. In view of

the ready availability of the catheter laboratory as well as its safety and ease of performance, emergency diagnostic pulmonary angiography is recommended in suspected clinical settings of pulmonary embolism [20] .Shortcomings are being Invasive prodecures Sensitivity and specificity match that of pulmonary angiogram.10% of spiral CT examinations are inconclusive compared to 12% for pulmonary angiograms.3 % of spiral CT angiograms will be technically inadequate compared to 4 % for pulmonary angiograms. Conventional pulmonary angiography is not precise for the diagnosis of pulmonary embolism limited to subsegmental arteries. To evaluate subsegmental arteries, techniques that improve the visualization of pulmonary embolism in small arteries should be used [9]

MAGNETIC RESONANCE ANGIOGRAPHY (MRA)

Thrombi appear as filling defects in the pulmonary artery on MRA. Thrombi of different ages present with different signal intensities on non enhanced spin echo imaging. Able to acquire images in the saggital and coronal planes. Smaller volumes of contrast media needed which is non nephrotoxic .MRA of pulmonary arteries can be combined with MR venography of the pelvis and femoral veins In one hour study , magnetic resonanace imaging (MRI) can provide a comphrensive work up of patient with suspected pulmonary embolism and deep vein thrombosis. Main draw back is that it is not as sensitive as spiral CT in the detection of pulmonary thromboemboli .Additionally, because the acquisition time for MRA exceeds that for CT or conventional angiography, selective pulmonary arterial phase enhancement cannot be achieved,making it difficult to distinguish arterial from venous structures. Breath-holding capability, registration artifacts, and poor differentiation of slow blood flow from thrombus also compromised image quality [21,22]

TREATMENT OF PULMONARY EMBOLISM

Diagnostic investigation should not delay empirical anticoagulant therapy.Immediate full anticoagulation after diagnosing deep vein thrombosis and pulmonary thromboembolism.Initial anticoagulation is started with i.v heparin. Simultaneously patient put in anticoagulants with warfarin.After therapeutic dose of warfarin is established, heparin is discontinued, and warfarin is maintained.

SURGICAL MANAGEMENT
CATHETER DIRECTED THROMBOLYSIS

This is started in acute DVT < 10 days. Urokinase 150,000 U/hr via multi-sidehole catheter. Heparin 500 U/hr. concomitantly via popliteal sheath Venograms every 12 hrs to reposition infusion devices

Inferior Vena Caval Filters

Indications:

(1) Active bleeding that precludes anticoagulation, and

(2) Recurrent venous thrombosis despite intensive anticoagulation.

Relative indications:

Prevention of recurrent pulmonary embolism in patients with right heart failure who are not candidates for thrombolysis

Prophylaxis of extremely high-risk patients.

Disadvantages:

The filter itself may fail by permitting the passage of small to medium-sized clots

Large thrombi embolize to the pulmonary arteries via collateral veins that develop.

A more common complication is caval thrombosis with marked bilateral leg swelling.

Paradoxically, by providing a nidus for clot formation, filters double the deep vein thrombosis rate over the ensuing 2 years following placement.

Percutaneous pulmonary embolism thrombectomy

This Involves aspiration, maceration and removing of thrombus .Greenfield suction embolectomy catheter is used .Balloon angioplasty or pigtail rotational catheter for thrombus fragmentation is used.

Surgical embolectomy

Embolectomy is through median sternotomy done under normothermia.Tranverse arteriotomy is done and clot extracted under vision using simple gallbladder stone forceps

Pulmonary embolectomy
Indication: Massive pulmonary embolism compromising cardiac output where thrombolysis has failed or is contraindicated. Experienced cardiac surgical cover essential .Where available, catheter transvenous extraction of emboli may be an alternative to pulmonary embolectomy

.Pulmonary endarterectomy is done in chronic recurrent pulmonary embolism with secondary pulmonary hypertension

PREVENTION

Heparin prophylaxis:

The incidence of venous thrombosis, pulmonary embolism and death can be significantly reduced by embracing a prophylactic strategy in high-risk patients. Prevention of deep vein thrombosis in lower extremities inevitably reduces the frequency of pulmonary embolism; therefore, populations at risk must be identified, and safe and efficacious prophylactic modalities should be used

Sequential compression devices

This device provides a gradient of compression that is highest at toes and gradually decreases to the level of thigh .Reduces capacitance venous volume by approximately 70% and increase the measured velocity of blood flow by a factor of 5 or more in low extremity veins .Universal white stockings known as antiembolic stockings or Ted stockings produce a maximum compression of 18 mm Hg .Gradient compression Pantyhose (30-40 mm Hg) are available in pregnant sizes .Compression stockings provide a compression of30- 40 mm Hg gradient to prevent venous thromboembolism in high risk cases where heparin is contraindicated

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