ISSN 2515-8260 Volume 9, Issue 4, Winter 2022

ROLEOFMDCTAORTOGRAMINEVALUATIONOFPATIENTSWITHMILD,MODERATEANDSEVEREHEMOPTYSIS

DrNithishaMaryJacob,DrSalilPandey,DrSureshA,DrNaveenS,DrKishorSagarV

Department of Radiodiagnosis & imaging, Vydehi institute of medical sciences & researchCentre,Whitefield,Bangalore

Abstract:

Hemoptysis is the expectoration of blood that originates from the lower respiratory tract. Itis usually a self-limiting event but in fewer than 5% of cases it may be massive, representingalife-threateningconditionthatwarrantsurgentinvestigationsandtreatment.Multidetectorcomputed tomography (MDCT) angiography is a useful examination to detect the source ofthebleedinginpatientswithhemoptysis.
TheaimofthestudywastostudytheroleofMDCTaortogramevaluationofpatientswithmild,moderateorseverehemoptysis.

Methods:Thestudypopulation included 41patients presenting withhemoptysiswhounderwentMDCTaortogramintheregionofthoraxafterapplyingtheinclusion andexclusioncriteria. The criteria's such as clinical presentation, analysis of lung findings on MDCT chestaortogram, analysis of vasculature on MDCT chest aortogram, correlation of MDCT findingswith conventional angiography /DSA in patients who underwent endovascular procedures,correlationofMDCTfindingswithbronchoscopic findingsinpatientswhounderwentbronchoscopy,andfinallyandCorrelationofMDCTfindingswithclinicalcourseofthepatientwereanalyzed.

Results:A total of 41 patients who presented with mild, moderate and severe hemoptysiswere analyzed using MDCT aortogram. Based on the findings on MDCT aortogram and theseverityofhemoptysis,thepatientsweretakenupforendovascular intervention formanagementofhemoptysisandthefindingsinconventionalangiographywascorrelatedwithMDCTangiography.

Keywords–Hemoptysis,MDCTaortogram,bronchoscopicfindings.

Introduction:

Hemoptysis is defined as expectoration of blood from the lower respiratory tract, i.e., fromtracheo-bronchial tree or the pulmonary parenchyma. Death is rarely caused by blood loss,ratheritisbyairwaycompromiseasaresultofseepageofbloodintotheairwaysandalveoli.

Hemoptysis is considered mild, moderate or severe depending upon the volume of bloodexpectorated by the individual. A volume of <100mL/ day is considered mild, 100-300mL perday is considered severe and >300ml per day is considered severe.Identification ofthesourceandcauseofbleedingisessentialfortheevaluation ofhemoptysis. MDCT aortogram plays an important role in detecting the cause of the bleed,prior

tointervention suchasbronchial artery embolization or surgical intervention, withgreateraccuracy[1].

Multi–detector row computed tomographic angiography allows for a noninvasive and rapidevaluationtoasseshemoptysis.Thismodeofimagingallowsforboththin-sectionaxialscansandmorecomplexreformattedimageswhichallowsforaclearerinterpretationoftheoriginsandanatomicalpathwaysofsystemicarteriesresponsibleforhemorrhage[2].

Bronchiectasis,chronicbronchitis,lungmalignancy,tuberculosis,andchronicfungalinfectionare various conditions responsible for hemoptysis which are routinely identified with MDCT.Vascular anomalies suchas pulmonary arteriovenous malformations and bronchial arteryaneurysmsarelesscommonlyencountered[3].

However recurrent hemoptysis could be a result of contributions from the non-bronchialsystemicarterialsystemfollowingbronchialarteryembolizationwhichneedsrapidevaluationand management. Hence the present study was planned to determine the specific causes ofhemoptysisonCTangiography,tocorrelatethe amountofhemoptysiswithbronchialarterialanatomyandcorrelatethefindingswithbronchialangiogramduringbronchialarteryembolizationwhereapplicable,tocorrelatethefindingsofCTangiography with bronchoscopic findings and tocorrelate the findings with patient's clinical coursein thehospital[4].

Materials andMethods:

Studydetails

Thestudy population included 41consecutive patients with mild,moderate ormassivehemoptysis who were referred to the department of Radiology for chest imaging and MDCTaortogramtoassessthelungpathology andvascularanatomy.Multidetector CTwasperformed on all the patients with Siemens. Somatom Definition AS 128 slice Multi-detectorCT scannerwith5mmcollimationandagantryspeedof0.05secandpitchof1.2sec,120kvPand 345 effective mAs. First, non- contrast axial cuts were obtained, thereafter contrast wasadministered (Omnipaque (Iohexol) -350 mg I/ml), typical doses of 1.5 mg/kg (60-90 ml)through pressure injector (Imaxeon, SW version- 1.5-.12)using smart prep software (RCUmanager) (FIG 4 & FIG 5) and ROI were kept at the descending aorta, after which arterialphasewasobtained[5].

Analysisperformed

The typical scan parameters involved 5 mm and 1 mm slice thickness, coronal, axial andsagittal reconstruction, with 120 MA and 60-80 Kvp. The CT examinations were analyzed ondedicated workstations, this included Aquarius systems (Aquaris Nutrition Edition Ver.4.4TERARECON ProtectedbyU.SPatent 6,826,297@1998-2009TeraRecon, Inc.Allrightsreserved) or Syngovia (127.0.0.1@ 2009-2016 Siemens Healthcare) dedicated work station.The analysis was performed of the axial cuts (5 mm), thin section reconstructions (1 mm).Multiplanar reformats were performed and image analysis was done

in multiple planes forthe details of the lung findings and pseudoaneurysms if any. Maximum intensity projections(MIP)wereperformedforvesselanalysis. Theanalysis wasperformedbyRadiologistsexperienced in cardiothoracic imaging and CT/MR angiography (> 5 years' experience). Theconventional angiograms and interventional procedures were performed by interventionalradiologyteam[6].

Inclusion and exclusion criteria:

Allpatients whopresent forMDCTthoracic aortogram andchestCTindepartment ofRadiologyandimagingwithmild,moderateormassivehemoptysisandinwhomthesiteandcauseo fthebleedwereultimately confirmed.Patientswithlifethreatening massivehemoptysis which required an emergent endovascular embolization procedure without anypriorMDCTanalysis,caseswhichwerenotreadyforanyfurthertreatmentfollowingimagingdia gnosis, patients inwhom adequate follow-up wasnot available, patients inwhom CTangiographyiscontra-indicatedsuchashighcreatininevaluessecondarytorenalinsufficiencyorallergytoiodinatedcontras tmediawereexcludedfromthestudy.Moreover,patientswithhemoptysisduetolungtumorsweregen erallyexcludedfromthestudy,sinceaCTangiography was not generally performed in them and a diagnosis of tumors was generallyestablished on conventional contrast enhanced CT (CECT) or PET CT. However patients withlungtumorspresentingwithseverehemoptysisinwhichanendovascularprocedurewas needed to be done were included in the study with a pre procedure CT angiography havingbeingperformedin thesepatients[7].

Statisticalanalysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 versionsoftware. Categorical data was represented in the form of Frequencies and proportions. Chi-squaretestwasusedastestofsignificanceforqualitative data. Continuous datawasrepresentedasmeanandstandarddeviation.

Results:

The study included 41 consecutive patients with mild, moderate or massive hemoptysis whowere referred to the department of Radiology for chest imaging and MDCT aortogram toassess the lung pathology and vascular anatomy, after applying the inclusion and exclusioncriteriamentionedabove.

Thisincluded31malesand10females.Theagerange ofthe patientswasfrom20to75yearsand mean age was 47. The age range in male patients was 20 to 71 and in female patientsfrom 21to75yearsandthemeanage ofmalepatientswas45andoffemalepatientswas48.The average duration of symptoms was of 1 month and ranged from 1 day to 15 years. All ofthepatientspresentedwithcomplaintsofhemoptysis.

There was acute onset of hemoptysis (onset within 2 weeks) in 10cases, while there was achronicpresentation(onsetgreaterthan2weeks)in31cases.Thequantification ofhemoptysiswasdoneand19patientshadmild(volumelessthan100ml/day)hemoptysis,ofthese 8had chronic streaky hemoptysis, 14patients had moderate hemoptysis (volumebetween 100 to 300 ml /day) while 8 patients had severe hemoptysis (volume greater than300 ml/day) . All

the patients with severe hemoptysis were however clinically stable withpreservedvitalsandhencecouldundergoaCTangiography priortoperforminganendovascular intervention. All the clinically unstable patients with severe hemoptysis withinstability of vitals, underwent emergent endovascular procedures and were not included inourstudy.

In addition to hemoptysis, note was made of additional presenting complaints such as chestpain, cough,feveranddifficulty inbreathing ,andofthesemostcommonadditionalcomplaintwaschestpainandcough,presentin30patients,whil edifficultyinbreathingwaspresent in 9 cases and fever in 5 cases . A relevant past history of any thoracic disease suchas tuberculosis, aspergilloma, bronchiectasis, lung tumors etc.was also noted to help inetiologicalanalysis.

Patients general condition: A note of patients general condition was done with respect tonoting of vital parameters such as heart rate, blood pressure and oxygen saturation (SPO2) .All the patients in our study had stable vitals, since all the patients with unstable vitals hadalreadybeentakenupfordirectendovascularprocedure.

Table1–Distributionofparameters:

	Count	%
Sex		
Female	10	24.4%
Male	31	75.6%
Age		
20 to30years	12	30%
31to40years	10	25%
41to50years	9	22.5%
51to60years	6	15%
>60years	3	7.5%
Categorizationofhemoptysis		
1. Streaky	4	9.75%
2. Mild	15	36.5%
3. Moderate	14	34%
4. Severe/massive	8	19.5%
Etiologydistribution		
ActiveTB	9	22.5%
PostTBsequelae	14	35%
Bronchiectasis	6	15%
LungMass	4	10%
COVID19	2	5%
Aspergilloma	2	5%
Typesofbronchialarteries		
1. TypeI	14	34%
2. TypeII	12	29%
3. TypeIII	2	4.8%
4. TypeIV	13	31%
CTangiographyfindings		
Normalbronchialarteries	20	48.7%

Hypertrophiedbronchialarteries	21	51.2%
Nonbronchialsystemiccollaterals -Absent -Present	 38 3	 92.6% 7.3%
Bronchopulmonaryshunts -Absent -Present	 37 4	 90.2% 9.7%
Pseudoaneurysms -Absent -Present	 38 3	 92.6% 7.3%

Analysisofthelungfindingson MDCTchestaortogram:

Thelungfindingswerenotedinsofttissue(mediastinal)andlungwindowsettings.Thelungswereco mpletely normal with nosignificant findings in2 patients. 14patients hadpostinfectivesequelaewithcavitation /fibrosisandbronchiectasis.9patients hadchangesconsistentwithactiveTBwithcentrilobular/tree-inbudnodulesinadditiontootherchangessuch as cavitation or fibrosis, 6 patients had only bronchiectasis as a predominant feature. Apattern of consolidation /air space opacities was present in 4patients signifying changesconsistentwithpneumonitis.Lungtumorsasacauseofsignificanthemoptysiswereidentifie din 4 cases. Additional findings such as interstitial lung disease in 2 patients, pleural pathologywiththickeningoreffusionin6patients.Onepatienthadacongenitaletiologywithsequestr ationasacauseofrecurrenthemoptysis.

AnalysisofvasculatureonMDCTchestaortogram:

Bronchial arteries could be identified in all cases in our study. The most common levels oforiginofthe bronchialarterieswerefrom T4toT8vertebrallevels.Majority(39cases)ofthebronchial arteries were noted originating from the descending thoracic aorta, which an archorigin was noted in 2 cases. Majority 30 of the bronchial arteries had an origin of within 2.5cm of carina.Type 1bronchial artery wasnoted in14patients, typeIIanatomy in12patients, type III anatomy in 2 patients, a type IV anatomy in 13 patients. However, types VtoVIIIweren'tencounteredinanyofourcases.

Hypertrophy of the arteries (defined as arterial diameter > 2mm in the proximal course) wasnotedin20patients,withhypertrophiedsinglearteryin16patientsandbilateralhypertrophied bronchials in 4 patients. In addition, in 8 patients there was hypertrophiedbronchial on one side with only one single hypertrophied branch with the other branch ontheipsilateralsidebeingnonhypertrophied.In21patientshypertrophiedbronchialwerenotnoted. Tortuosity of the bronchial arteries defined as undulating course of the artery withwavy appearance, was noted in 27patients and tortuosity of the arteries coexisted withhypertrophyofthearteries,seenin11patients.Presenceofanyaneurysms/pseudoaneurysms or active arterial contrast extravasation from the bronchial arteries or itsbranches was not seen in

any of the patients in our study. An attempt was made to identifyany spinal cordbranchesarising fromthebronchial arteries inourstudy withspecificattention to spinal course with hair pin bend, however any such spinal branches were notidentifiedinourstudy. Two cases however had direct pulmonary arterial involvement with pulmonary artery pseudoaneurysms identified in both, one a case of Rasmussen aneurysm in a case of active TB and another a case of large left pulmonary artery pseudoaneurysm in a case of necrotizing pneumonia in background of post COVID sequelae of post COVID interstitial fibrosis.

Hypertrophiednonbronchialsystemiccollateralswerepresentin9andtortuositywasnoted in 5 patients. Of these most common was supply from internal mammary artery in 3patients, while in 5patients there wassupply fromintercostal arteries, 3patients fromcostocervical trunk, 1 patient from thyrocervical trunk and axillary artery branches (chieflylateral thoracic artery) in 3 patients. The predominant pattern of hypertrophy and tortuositycorrelated with the supply to the diseased lung parenchyma along with abnormal blush andhypervascularityintheinvolvedregions.Inoneofthepatientswithacongenitalbronchopulmonarysequestration,wasthereapseudoaneurysmfromthesupplying intercostalarterybranch, in noneof the other patientswas there an aneurysm /pseudoaneurysmarisingfromtheabnormal non-bronchial systemiccollateral arteries.

CorrelationofMDCTfindingswithconventionalangiography:

16patientsunderwentendovascularprocedurebasedontheMultidisciplinaryteamdiscussion (MDT) involving the departments of Respiratory Medicine, General Medicine andInterventionalRadiology.Typically,allpatientswithseverehemoptysisunderwentendovascularprocedure.5patientswithmildormoderatehemoptysisunderwentendovascular procedures since the symptoms were recurrent or not effectively controlledwithmedications,bronchoscopicinterventionsorconservativemeasures.

Oncomparing the findings of CT angiography against the conventional angiography /DSA,considering the latter as gold standard, we found CT angiography to be 98% accurate indemonstrating the bronchial anatomy type with correlation between the two modalities (pvalue <0.03). CT angiography was 98% accurate in demonstrating the site of origin of thearteryfromtheaortaand100%accuracy(sensitivity-100%,specificity-100%,PPV-100%,kappa value-1) was obtained in correctly predicting the hypertrophy and tortuosity.Overall CT correctly predicted the abnormal site of vascularity in all cases with respect to thebronchialcirculation.

With respect to the non-bronchogenic systemic collaterals, CT correctly demonstrated thesupplyin3cases,howeveradditionalnon-bronchogenicsystemicsupplynotclearlydemonstrated by CT angiography was picked up on conventional angiography in 6 cases. CTalso correctly demonstrated the pseudoaneurysm from the intercostal artery in a lone caseofsequestrationinourstudy.

CorrelationofMDCTfindingswith theclinicalcourseofthepatient:

Hypertrophy and tortuosity of the bronchial arteries correlated with increasing severity ofstenosis with8casesofmoderate orseverestenosis demonstrating hypertrophied andtortuous bronchial arteries, while in 10 cases with moderate and severe hemoptysis werebronchial

arteries normal. Chiefly this scenario was noted in conditions such as aspergillomawith cavity and internal contents, where in 2 cases, there was no bronchial hypertrophy,despitesignificantrecurrentbleed.Alsoinbleedinglungtumor,seenin4 cases,therewasnosignificant hypertrophy and only a vague tumor blush. A hypertrophy and tortuosity of thebronchial arteries was noted in 8 cases with streaky or mild hemoptysis, while in 11 of thesecases the arteries were normal. Overall, 50% of caseshaving severe hemoptysis showednormalbronchialarteriesandtheother50%showedhypertrophiedbronchialarteries.

In9patientswhounderwentendovascularintervention,thebronchialarterieswerehypertrophied, while they were normal in 7 patients in endovascular intervention group.Overall, 9 patients who underwent MDCT angiography who showed hypertrophied bronchialarterieswereta kenupforconventionalangiographyforimmediateintervention. PatientswithsignificantfindingsonCTangiographyincluding hypertrophied bronchialarteries,significantrecruitmentofnon-bronchialsystemiccollateralsandpresenceofpulmonary artery pseudoaneurysms, had need for endovascular intervention or prolongednonvascularmanagementwithsubsequentprolongedlengthofhospitalstay(meanduratio n-1week),comparedtopatientswhodidnothavethesefindings(mean4days).Alsopatientswiththesefi ndingshadmoreneedforICUadmissionstay(2%patients),comparedtopatientswhodidnothaveabo vefindings(none).

Discussion:

Hemoptysis is defined as expectoration of blood from the lower respiratory tract, i.e., fromtracheo-bronchialtreeorthepulmonaryparenchyma.

Hemoptysis is considered mild, moderate or severe depending upon the volume of bloodexpectorated by the individual. Identification of the source and cause of bleeding is essentialfor the evaluation of hemoptysis. MDCT aortogram plays an important role in detecting thecause of the bleed, prior to intervention such as bronchial artery embolization or surgicalintervention,withgreateraccuracy[8].

Multi–detector row computed tomographic angiography allows for a noninvasive and rapidevaluationtoasseshemoptysis.Thismodeofimagingallowsforboththin-sectionaxialscansandmorecomplexreformattedimageswhichallowsforaclearerinterpretationoft heoriginsandanatomicalpathwaysofsystemicarteriesresponsibleforhemorrhage.

Bronchiectasis,chronicbronchitis,lungmalignancy,tuberculosis,andchronicfungalinfectionare various conditions responsible for hemoptysis which are routinely identified with MDCT[9].

MDCT aortogram can play a valuable role in evaluating patients with hemoptysis. With theexception of those presenting in an emergent life threatening settings with unstable vitals,requiring urgent endovascular procedures, in remainder of the stable patients or those withchronic symptoms, MDCTangiographic evaluation can provide detailed information of thelungparenchymalaswellasvascularinvolvements,helpinginplanningsubsequenttreatmentfor these patients. However prior to proceeding with this investigation, a careful applicationof the mentioned inclusion and exclusion criteria needs to be done in all cases. A thoroughclinical

assessment ofthese patients with respecttoclassification and categorization ofhemoptysis,etiologicalworkupandassessmentofvitalsisessentialpriortoproceedingtoCTexam. Evaluationofthelungparenchymalpathologyprecedestheanalysisofthevasculatureandhelpsinlocalizingthepathology[10].

Analysis of the vasculature involved a detailed assessment of three principal axis which maybe responsible for bleedings either solely or incombinations, these include the bronchialarteries,thenon-bronchial systemiccollaterals andthepulmonary arteries.Analysis ofdifferent aspects of the bronchial arterial or the non-bronchial systemic arterial supply wasfound to have significant impact on effectively planning subsequent endovascular procedureandarrangingtherequiredhardwareneededtocannulatethesevessels.Thebronchial

arterial patterns and anatomy can be very heterogenous and varied and MDCT aortogramprovides an optimal evaluation ofthese features. Similarly MDCTaortograms effectivelydetails the non-bronchial systemic collaterals , however conventional angiography /DSA ismore effective in demonstrating the finer branching patterns as well as reveals additionalinvolvementssuchasfromtheaxillaryarterybranches.Thepulmonaryarterialinvolvements areusually obvious on MDCTaortograms withexquisitely demonstrated aneurysms andpseudoaneurysmsandanyadditionalpulmonaryarterialhypervascularitygenerallyrepresentsshuntsratherthandirectarterialsupplyandmaynotneedendovascularprocedurefromthepulmonaryarterialside.Overall,thereisanexcellentcorrelationwiththefindingsonMDCTaortogramsandthoseofDSA/conventionalangiography[11].

Conclusion:

Furthertherapeuticdecisionforthemanagementofthesepatientsarebesttakeninurgentlycalled MDTs of the relevant clinical departments and the MDCT aortogram findings play animportant roleintheseMDTswithrespecttotherapeutic decision making.Findings ofhypertrophied arteries and significant non-bronchial systemic collaterals generally signifiessignificant (moderate or severehemoptysis)and need forendovascular interventions ,however in few cases these findings may not correlate and the patient may have mild orstreaky hemoptysis and respond well to conservative measures . Hence correlation of thesefindingswiththeclinicalscenarioofthepatientsisimportant.Also,incertainconditionssuchas bleeding tumors and aspergilloma, there may be absence of significant hypertrophy ofarteries despite severe bleeding and presence of parenchymal staining or blush are moreoften present. MDCT findings also correlated with other clinical features such as length ofhospitalstayandneedforICUadmission[12].

References:

1. LandingBH,DixonLG.Congenital Malformations andGeneticDisordersoftheRespiratoryTract:(Larynx,Trachea,Bronchi,andLungs).Americanreviewofrespiratorydisease.1979Jul;120(1):151-85.
2. AgarwalPP,Kazerooni EA.High-Resolution CTinthe Multidetector CTEra.NewTechniquesinCardiothoracicImaging.2007Aug20:145-62.

3. Abdel-Ghany AF, Nassef MA, Osman NM. Multidetector CT chest with bronchial andpulmonary angiography determining causes, site and vascular origin of bleeding inpatients with hemoptysis. The Egyptian Journal of Radiology and Nuclear Medicine.2013Dec 1;44(4):769-78.

4. Van den Heuvel MM, Els Z, Koegelenberg CF, Naidu KM, Bolliger CT, Diacon AH. Riskfactorsforrecurrenceofhaemoptysisfollowingbronchialarteryembolisationforlife-threatening haemoptysis. The International Journal of Tuberculosis and Lung Disease.2007Aug1;11(8):909-14.

5. McLoudTC.ThoracicRadiology:TheRequisitesE-Book.ElsevierHealthSciences;2010Apr29.

6. Hong W, Ha HI, Lee JW, Lee SM, Kim MJ. Measurement of pancreatic fat fraction byCT histogram analysis to predict pancreatic fistula after pancreaticoduodenectomy.Koreanjournalofradiology.2019Apr;20(4):599-608.

7. LeHY,LeVN,PhamNH,PhungAT,NguyenTT,DoQ.Valueofmultidetectorcomputedtomographyangiographybeforebronchialarteryembolizationinhemoptysismanagement and early recurrence prediction: a prospective study. BMC PulmonaryMedicine.2020Dec;20(1):1-0.

8. Colice GL. Hemoptysis: three questions that can direct management. Postgraduatemedicine.1996Jul1;100(1):227-36.

9. IsmaeelAM,NassefMA,AzmyMF,KhalilMM.Roleofmultislicecomputedtomography in patients presenting with hemoptysis. The Egyptian Journal of HospitalMedicine.2012Oct1;49(1):732-50.

10. BarstRJ,McGoonM,TorbickiA,SitbonO,KrowkaMJ,OlschewskiH,GaineS.Diagnosisanddifferentialassessmentofpulmonaryarterialhypertension.JournaloftheAmericanCollegeofCardiology.2004Jun16;43(12S):S40-7.

11. Hartmann IJ, Screaton NJ. Pulmonary circulation and pulmonary thromboembolism.Grainger&Allison'sDiagnosticRadiology,2VolumeSetE-Book.2020May25:397.

12. BergerFH,BooDW.Blunttraumaticaorticinjury.InEmergencyRadiologyoftheChestandCardiovascularSystem2016(pp.79-103).Springer,Cham.

SUPPLEMENTARY DATA

CASE 1

40 year old male patient with an episode of massive hemoptysis of 500ml , preceded by multiple episodes of mild hemoptysis in the past 2 years .Known case of TB on ATT .

CT findings

A large irregular cavity is noted in the right upper lobe with adjacent consolidation and pleural thickening.

Multifocal irregular nodules and masses with spiculations and radiating fibrous strands noted in both lung fields predominantly in the upper lobes. Multifocal air spaces and centrilobular nodules with patchy ground glass opacification noted in both lung fields. Peri-bronchovascular thickening in right hilum with narrowing of the right main bronchus and adjacent lobar / segmental bronchi. Bilateral bronchial arteries appear hypertrophied supplying the involved lung segments.

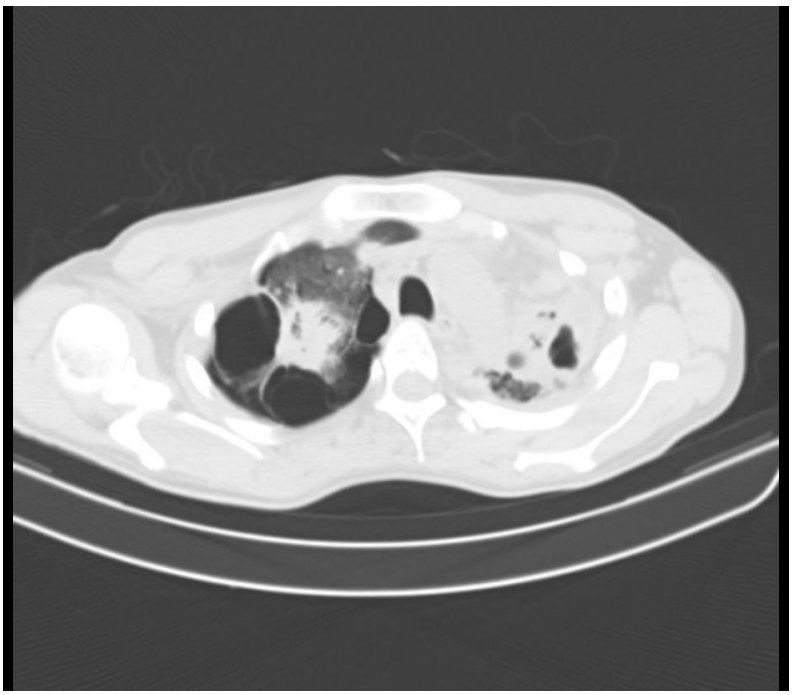
CASE 2

- 27 years old male came with complaints of massive haemoptysis, 2 episodes of more than 400 ml.
- Multiple mild episodes in the past 1 year off and on

CT findings

Showed features suggestive of sequelae of pulmonary Kochs in both lung fields with volume loss, bronchiectatic changes with fibrosis and collapse of left upper lobe with mediastinal shift. Dilated and tortuous left bronchial and posterior intercostal arteries with no evidence of contrast extravasation/pseudoaneurysms from bronchial arteries.

Collapse and mediastinal shift to the left with multiple emphysematous bullae on the right



The common trunk of origin of both bronchial arteries could not be clearly delineated on CT angiography.Hypertrophied posterior intercostal artery on CT angiography.

CASE 3

57 years old male patient presented with recent onset massive hemoptysis. Total 3 episodes – one of 400 ml and others of 150 to 200 ml (over 1 week).

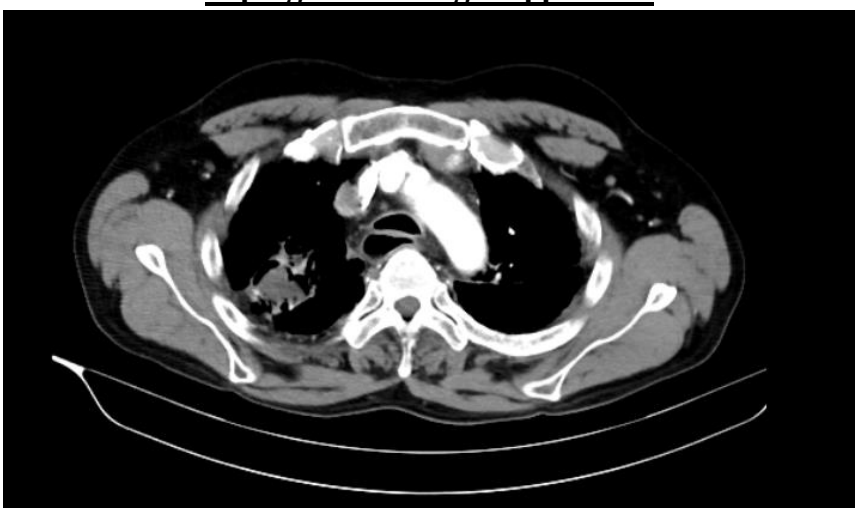
CT findings

-Cavity with aspergilloma in the apical segment of right upper lobe.

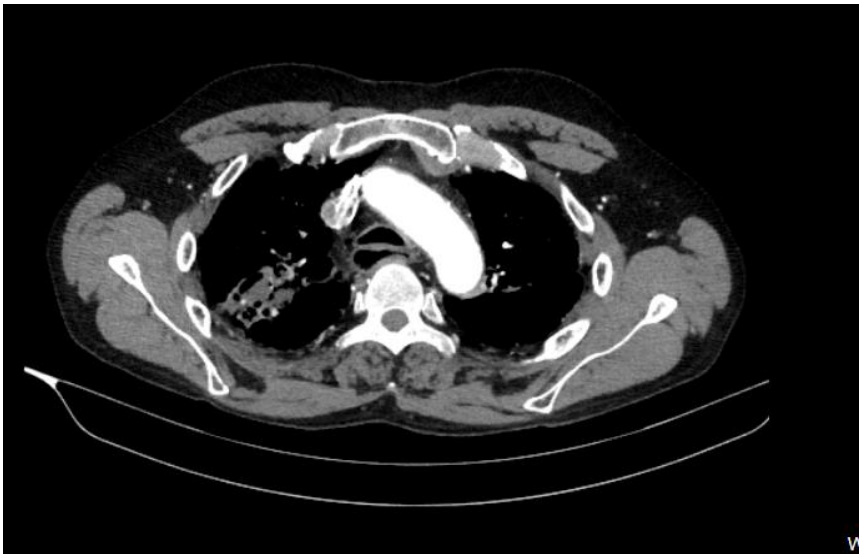
-Bilateral apical fibrosis- S/o sequelae of old tuberculosis.

-Para septal and centri- acinar emphysematous changes with bibasal fibrosis.

Aspergilloma of right upper lobe



Predominant supply to the cavity from the right bronchial artery branches



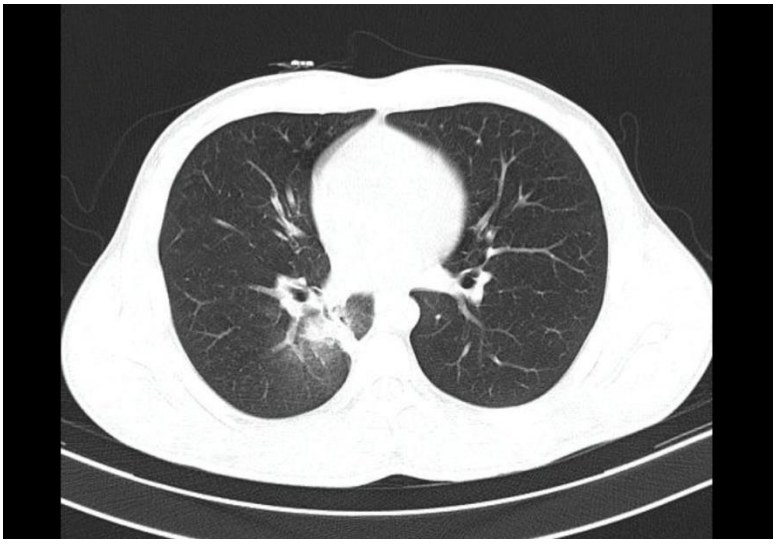
CASE 4

A 21-year male presented with recurrent streaky haemoptysis with mild right sided chest pain on and off since 5 years.

The haemoptysis was mild in quantity, typically streaky in nature.

CT findings

CT showed a well-defined round consolidation /soft tissue mass in the posteromedial segment of right lower lobe, note that the lesion attached to the adjacent pleural by a stalk. The bronchi is seen draping around the lesion without actually supplying the lesion as shows in the figure below.



MDCT aortogram shows an enlarged artery from the descending aorta supplying the lesion

There was intralesionalhypervascularity and a small pseudoaneurysm was also visualised, this likely was the cause of recurrent haemoptysis.It could have been the result of recurrent infections within the lesion.Angiography confirmed a large artery arising from the descending thoracic aorta and supplying the lesion with extensive neovascularity which was subsequently embolised using 300microns PVA particles.