肺癌血管影像学 ·

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肺癌侵犯肺动脉干CT、MRI表现、病理基础及其对手术治疗的价值

缪[illegible]陶 周瀚 朱培菊 白红利 胡颖川 周清华

【摘要】 **目的** 研究肺癌侵犯肺动脉干(cancerous invasion of the main pulmonary artery, CIMPA)CT、MRI征象的病理基础及对手术治疗的价值。**方法** 研究对象为中央型肺癌23例(螺旋CT 15例,MRI 13例)。观察和分析其CT、MRI征象,并与手术/病理发现作前瞻性盲法对照研究。**结果** 本组23例肺癌CIMPA的CT/MRI征象为:管壁增厚征(CT 73.7%,MRI 84.6%),管腔缩窄征(CT 55.3%,MRI 69.2%)及管周脂肪征(CT及MRI均为100.0%)。依肿块与血管的密切关系分为:相贴型(CT 10例,MRI 7例),即肿块与血管相贴小于180°,无或轻度管腔狭窄;包埋型(CT 5例,MRI 6例),即血管被包埋大于180°,伴中至重度缩窄。手术发现相贴型10例,全部行肺叶切除并血管成型术。包埋型13例,7例全肺切除,4例肺叶切除并血管成型术,2例未切除。21例切除标本镜下观察:癌肿侵犯肺动脉外膜100.0%(21例)、中膜66.7%(14例)、内膜4.8%(1例)。相贴及包埋两型在癌肿浸润肺动脉深度上无显著性差异($P>0.05$);所有标本均显示急性或慢性炎性组织增生。CT、MRI与病理分型一致性好(Kappa值各为0.61、0.84)。**结论** 本组肺癌CIMPA的CT、MRI特征为肿块相贴或包埋血管,致管壁增厚及管腔缩窄但无闭塞,与癌肿主要侵犯肺动脉中、外膜伴结缔组织增生的病理表现相关。将病变分为相贴及包埋型有助于外科治疗计划的制订。

【关键词】 肺肿瘤 肺动脉干 断层摄影术,X线计算机 磁共振成像 病理学
【中图分类号】 R734.2;R445.3

CT and MRI findings of cancerous invasion of the main pulmonary artery in lung cancer: the correlation with pathologic features and the value in making surgical plan

MIAO Jingtao, ZHOU Han, ZHU Peiju, BAI Hongli, HU Yingchuan, ZHOU Qinghua. * Radiology Department, The First Affiliated People's Hospital, Medical School, Shanghai Jiaotong University, Shanghai* 200080, *P. R. China*

【**Abstract**】 **Objective** To study the correlation between CT/MRI features and surgical and pathological findings of cancerous invasion of the main pulmonary artery (CIMPA) in lung cancer and to evaluate the role of CT and MRI in making surgical plan. **Methods** CT findings in 15 cases and MRI findings in 13 cases were observed and blindly compared with surgical and pathological findings in this prospective study of 23 cases of central type lung cancer. **Results** The CT and MRI features showed as follows: the wall thickening sign in 73.7% of CT and 84.6% of MRI; lumen narrowing sign in 55.3% of CT and 69.2% of MRI; peri-vascular fat sign in 100.0% of both CT and MRI. Two types of CIMPA were visualized: contacted type (10 cases in CT and 7 cases in MRI) and encased type (5 cases in CT and 6 cases in MRI). Surgically, contacted type was found in 10 cases who all underwent lobectomy with sleeve-angioplasty. Encased type was found in 13 cases, among whom unresectable in 2, pneumonectomy in 7, and lobectomy with angioplasty in 4. Of the 21 resected specimen, the cancerous infiltration was demonstrated 100.0% (21/21) in adventitia, 66.7% (14/21) in media and 4.8% (1/21) in intima. There was no significant difference in the deepness of the cancer infiltration between the two types ($P>0.05$). Acute or chronic inflammatory infiltration which enhanced the thickening of the wall were shown on all specimens. CT and MRI findings were well corresponding to surgical and pathological appearance (Kappa value = 0.61 in CT and 0.84 in MRI). **Conclusion** In our study of CIMPA, CT and MRI features characterized by wall thickening and lumen narrowing without occlusion are closely correlated with pathological findings that cancerous invasion prominently limited adventitia and media with remarkable proliferation of connective tissue, and classifying two types is valuable in making surgical plan.

【**Key words**】 Lung neoplasms Main pulmonary artery Tomography, X-ray computed Magnetic resonance imaging Pathology

肺癌侵犯肺动脉干(cancerous invasion of the main pulmonary artery in lung cancer,简称肺癌CIMPA)属于ⅢB期,长期以来被列入手术禁忌范畴。近代胸外

作者单位:200080 上海交通大学医学院附属第一人民医院放射科(缪[illegible]陶);四川省人民医院影像科(周瀚);四川大学华西医院放射科(朱培菊、白红利、胡颖川),胸心外科(周清华)

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科学的进展,使肺癌 CIMPA 患者了获得手术机会。早期发现、早期诊断及准确判断病变范围及程度,对成功的外科治疗是至为关键的因素。鉴于国内外文献中对 CT 及 MRI 在肺癌 CIMPA 外科治疗计划中的价值和作用鲜有报告,本文首次通过对 23 例中央型肺癌 CIMPA 的 CT、MRI 征象与手术病理进行前瞻性对照研究,探讨 CT、MRI 征象及其分型对CIMPA诊断及手术治疗中的价值。

1　材料和方法

1.1　病例资料　本文收集经手术或/和病理证实为 CIMPA 的中央型肺癌 23 例,包括男性 19 例,女性 4 例,平均年龄 55.3 岁。左肺上叶 18 例,右肺上叶 5 例。组织学类型为鳞癌 15 例,腺癌 1 例,腺鳞癌 4 例,小细胞未分化癌 3 例。

1.2　CT、MRI 检查　检查方法:CT 检查 15 例。采用 Siemens Somaton Plus 4 VA 螺旋 CT 机扫描。螺距 1.0(准直/床进 10 mm/10 mm),8 mm 重建,扫描时间为 0.75/360°。全部病例用 60 % Angiografin 80～100 ml,以 3 ml/s 速度经肘正中静脉团注增强。

MRI 检查 13 例。采用 Elscent Gyrex V 0.5T 低温超导 MR 机扫描,Gyrex View 行图像后处理。SE 序列横断及冠状 T1W 像,层厚 8 mm,间隔 3 mm。快速 GRE 序列横断及顺血管轴向 T2W* 像。均使用体部线圈,呼吸门控。

三名放射科医生根据 CT、MRI 肿块优势部位及其与肺动脉干关系,观察肺动脉干管壁、管腔、管周脂肪改变。根据肿块与肺动脉干之间的密切关系对CIMPA做出分型。

1.3　手术及病理检查　术中观察肿块与肺动脉干关系。在切除标本上,沿肺动脉干纵轴及横轴切开观察,取材、固定、包埋切片后,行 HE 染色。镜下观察,肺动脉干外、中、内膜任何一层发现癌细胞或癌巢即诊断为 CIMPA。

1.4　统计学处理　用观察一致率判断肺癌 CIMPA 的 CT、MRI 征象与手术病理分型的相关性。Kappa > 0.4 为具有较好一致性,$\chi^2 < 0.05$ 为具有显著性差异。

2　结果

2.1　CT、MRI 征象

2.1.1　基本征象　见表 1。管壁增厚征:管壁增厚、僵直,肿块与管壁呈等密度或等信号。管腔狭窄征:管腔缩窄,内膜面光滑,但凹凸不平,血流信号正常或异常。管周脂肪征:肿块与受累血管之间管周脂肪 CT 密度增高或呈 MRI 中等信号。

表 1　23 例肺癌 CIMPA CT、MRI 基本征象与分组

Tab 1　CT/MRI features and classification of cancerous invasion of the main pulmonary artery (CIMPA) in lung cancer ($n = 23$)

Item	*N*	Wall thickening sign	Lumen narrowing sign	Peri-vascular fat sign
CT				
Contacted type	10	9	5	12
Encased type	5	2	3	3
Total	15	11(73.3 %)	8(55.3 %)	15(100.0 %)
MRI				
Contacted type	7	6	3	7
Encased type	6	5	6	6
Total	13	11(84.6 %)	9(69.2 %)	13(100.0 %)

2.1.2　分组　按肿块与肺动脉干关系分为两型。

相贴组:CT 10 例,MRI 7 例。肿块与肺动脉干管壁相贴小于 180°。在二维断面像显示与肿块相贴的一侧管壁呈等密度或等信号增厚。管腔正常或因管壁僵直轻度缩窄。肿块与管壁相贴部位管周脂肪中断或模糊(图 1)。

包埋组:CT 5 例,MRI 6 例。肿块包埋肺动脉干大于 180°。二维断面像显示两侧管壁均增厚。MRI 冠状位显示肿块自外侧壁向上或/和向下侧壁对肺动脉干形成钳状或环状包埋,管腔呈扁状或向心性缩窄。全部病例管周脂肪征阳性(图 2)。

本组 23 例中,无一例出现管腔充盈缺损征、腔内肿块或管腔闭塞征象。

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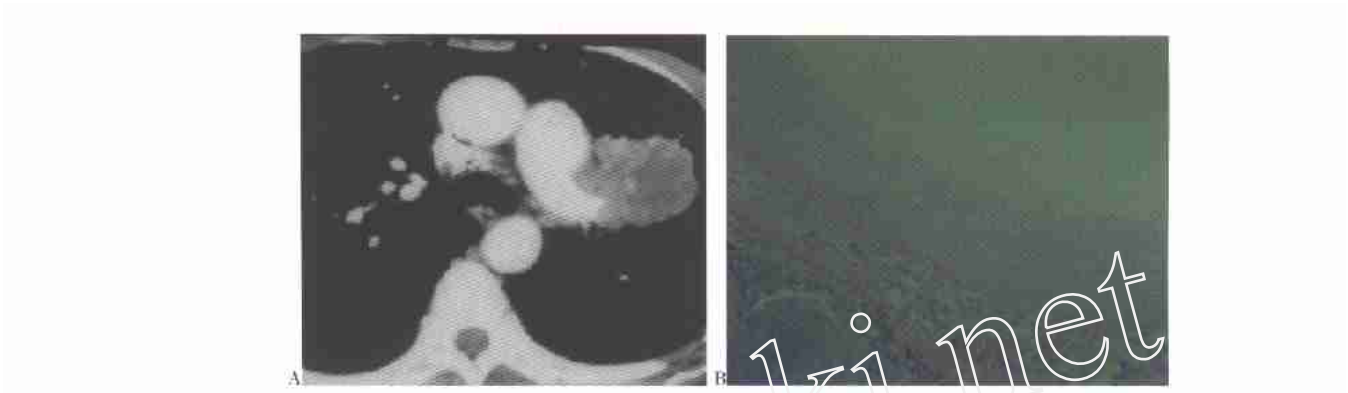

图 1 男,41 岁,鳞癌,CIMPA 相贴型,肺叶切除术并袖状成型术后

A:CT 片显示左肺上叶肿块与左肺动脉弓外侧壁相贴,血管壁尚清晰,管腔无狭窄;B:切除标本镜下观察,管壁增厚,癌巢浸润集中在外膜,纤维结缔组织增生(HE 染色 ×40)。

Fig 1 Male, 41-year-old, squamous cell carcinoma, contacted type of CIMPA in lung cancer, underwent lobectomy with sleeve-angioplasty

A: CT scan showed arch of left pulmonary artery was contacted with tumor mass of left upper lobe without obvious lumen narrowing and inner margin of lumen was still clear. B: Microscopic observation displayed thickening of vessel wall and most cancerous infiltrations located in adventitia with remarkable proliferation of connective tissue (HE staining ×40).

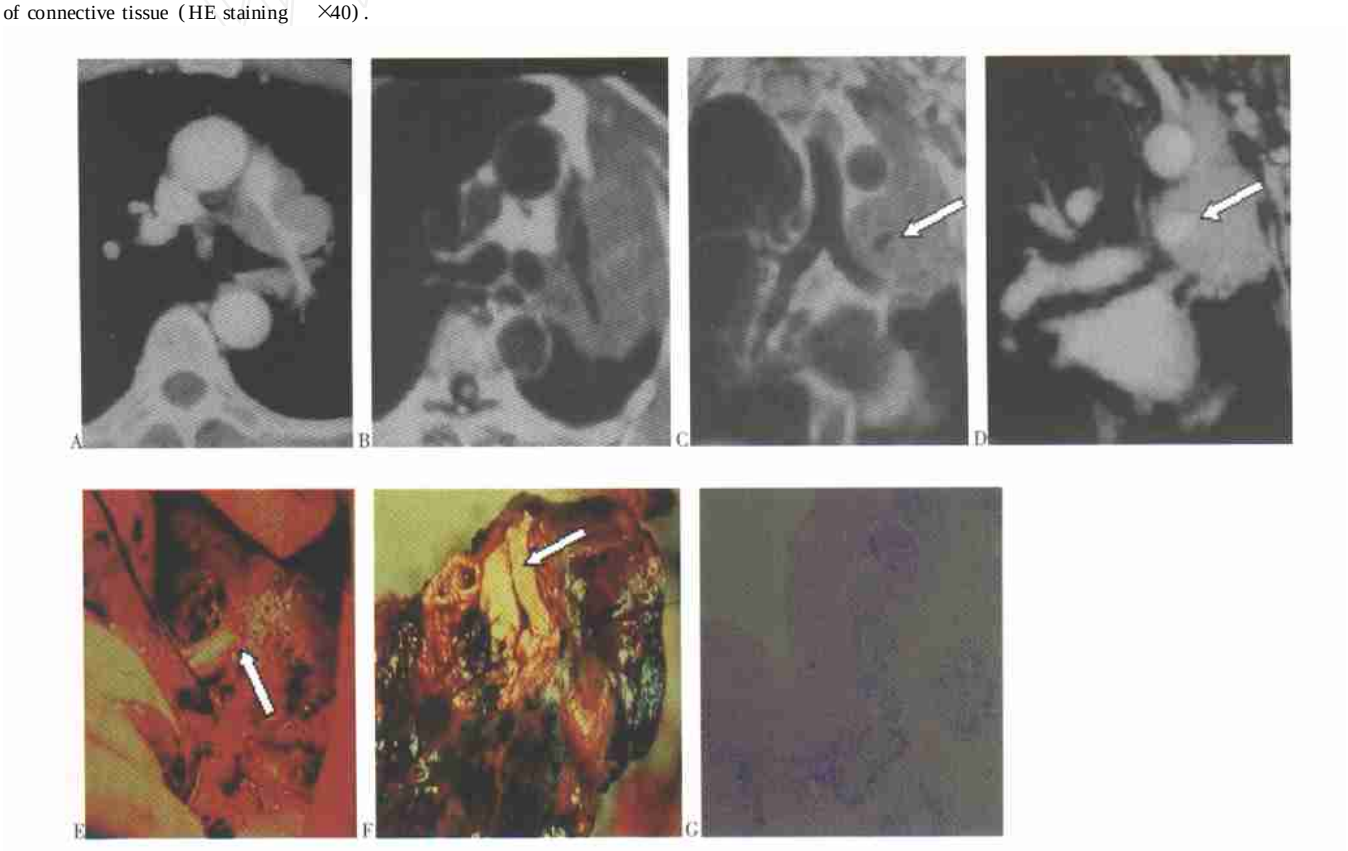

图 2 男,61 岁,左肺上叶鳞癌,CIMPA 包埋型,行支气管肺动脉袖状成形左上肺叶切除术

A:CT 片显示左肺上叶肺癌,肿块包埋左上肺动脉弓。血管管腔不规则狭窄,管壁光滑锐利;B 和 C:MRI 横断位和冠状位 SE 序列 T1W 相,左上肺动脉弓被肿块包埋 360°,管周脂肪征阳性,管腔显著狭窄,但内壁光滑锐利,保持血液流空征象;D:GE 序列冠状位,显示左肺动脉弓不规则狭窄的管腔;E:术中发现肿块包埋左肺动脉弓近侧段,暴露远侧段;F:切除标本横剖面,显示缩窄的血管腔,内膜面呈光滑的沟壑状;G:镜下显示,管壁显著增厚,内膜面光滑而凹凸不平,癌巢分布在中膜外弹力膜周围,管壁纤维结缔组织增生显著(HE 染色 ×40)。

Fig 2 Male, 61-year-old, squamous cell carcinoma in the left upper lobe, encased type of CIMPA in lung cancer, underwent lobectomy with sleeve-angioplasty

A: A(CT), B and C (MRI axial and coronal scanning, T1 weight) showed arch of left pulmonary artery was encased by carcinoma of left upper lobe with irregular lumen narrowing and inner margin of vessel wall was clear. D: MRI (coronal scanning, GE sequence) displayed irregular lumen narrow-ing of arch of left pulmonary artery. E: Proximal part of left pulmonary artery encased by tumor was found in operation (distal part of left pulmonary artery was displayed). F: Narrowing vessel lumen with wrinkle but clear inner surface was shown in morphologic observation of resected specimen. G: Microscopic observation showed most cancerous infiltration located in surrounding outer elastic membrane of the media with remarkable proliferation of connective tissue, and the intima was clear (HE staining ×40).

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2.2　手术及病理发现　23 例中央型肺癌均经手术及病理证实肺癌 CIMPA。除 2 例行剖胸探查术,手术切除获取标本 21 例。根据手术及病理发现,CIMPA 被分为两型,即相贴型和包埋型(表 2)。

相贴组:10 例。全部行肺叶切除加支气管/肺动脉双袖状成型术。癌肿与管壁局部(< 180°)紧密粘连不能剥离。切除标本剖面观察,肿块相贴部分内膜面僵硬,管腔正常或轻度缩窄。镜下发现外膜均受癌肿浸润,其中 6 例同时累及中膜,大部分癌细胞集中在中膜外弹力层周围。管壁全层显示明显的炎性细胞浸润、水肿。肿块与管壁相贴之管周脂肪水肿伴癌细胞浸润。

包埋组:13 例。4 例行肺叶切除加双袖状成型术,7 例全肺切除(其中 2 例行上腔静脉置换术),2 例同时累及主动脉者未切除。11 例切除标本中均发现癌肿包埋管壁(> 180°),剖面显示管腔缩窄,内膜面光滑但皱缩呈"沟壑"状。1 例局部粗糙,有薄层癌栓形成。镜下观察,管壁明显增厚,内膜面凹凸不平,癌肿侵及外膜,其中 9 例侵及中膜,大部分癌巢仍集中在外膜及中膜的外弹力层周围。1 例侵及内膜并有内膜面薄层癌栓。所有标本均见肉芽组织及瘢痕增生、玻璃样变。

统计学处理显示,癌肿侵犯深度与上述病理分型无相关性,$P > 0.05$(表 3)。

2.3　分型对照　CT、MRI 征象与手术病理分型对照,两者具有良好的一致性,Kappa 值分别为 0.61 和 0.84(表 3)。

表 2　21 例肺癌 CIMPA 手术切除标本病理表现

Tab 2　The pathological features of the surgical specimen of CIMPA in 21 lung cancer

Group	Cancerous infiltration degree			Wall inflammation	
	Adventitia	Media	Intima	Inflammatory infiltration	Granulation hyperplasia
Contacted type	10	5	0	7	3
Encased type	11	9	1	5	6
Total	21(100.0%)	14(66.7%)	1(4.8%)	12(57.1%)	9(42.9%)

表 3　23 例肺癌 CIMPA CT、MRI 与手术病理分型对照

Tab 3　Comparison between CT mad MRI type and pathological type of CIMPA in 23 lung cancer

Group	Pathological classification		Total	Kappa value
	Contacted type	Encased type		
CT				
Contacted type	7	3	10	
Encased type	0	5	5	
Total	7	8	15	0.61
MRI				
Contacted type	6	1	7	
Encased type	-	6	6	
Total	6	7	13	0.84

3　讨论

3.1　肺癌 CIMPA 的病理解剖　1928 年 Simpson 已提出肺癌侵犯肺动脉的病理依据。此后,文献报道[1~4]肺癌手术切除标本中,中、小肺动脉受侵者占 17%～58%。由于肺动脉干受侵属于 ⅢB 期,国内外文献甚少涉及手术切除标本的病理改变。本组 23 例肺癌 CIMPA 具有以下三方面特征:肺癌浸润管壁以中、外膜为主(分别为 66.7%及 100.0%),少有侵及内膜(4.8%),无癌栓形成;管壁全层炎性反应及结缔组织增生构成管壁增厚;管腔缩窄及变形显著但保持开放。肺癌 CIMPA 的病理改变具有自身的解剖和生理基础:肺动脉干管壁结构与体循环大动脉相似,属于弹性动脉[5],其中膜多达数十层的弹力纤维构成机械屏障,在一定程度上阻碍癌肿向深层及沿管壁长轴方向的广泛浸润;癌肿刺激和机体自身免疫反应导致的纤维结缔组织增生[1],在一定程度上加强了管壁与癌肿浸润的对抗。

本组肺动脉干病变中癌栓发生率低(仅一例),未发现管腔完全闭塞病例。与肺癌 CIMPA 病理征象形成鲜明对比的是,癌肿浸润肺静脉干时,肿块在包埋或粘贴管壁的同时,常常浸润或破坏管壁全层并突入管腔形成腔内肿块,与此同时,肺静脉干癌栓发生率高达 22.5%[6],三种因素的综合,使管腔部分或完全闭塞

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成为肺癌侵犯肺静脉干的常见病理改变。

3.2 肺癌 CIMPA 的 CT、MRI 征象及其与手术/病理的相关性 肺癌 CIMPA 的 CT、MRI 征象与其病理解剖改变密切关系。由于癌肿浸润伴有显著的结缔组织增生,使管壁增厚成为本组主要基本征象,分别占 CT 组 73.3 %及 MRI 组 84.6 %。本组 23 例中,超过一半的病例(CT 55.3 %, MRI 66.9 %)显示肺动脉干管腔狭窄征。值得注意的是,无论其为中度或重度狭窄,无一例发生管腔闭塞,与前述管腔病理改变极为吻合。在 CT、MRI 像上,开放的管腔腔面凹凸不平,但保持光滑、锐利,与管壁癌肿主要集中在中、外膜以及癌肿和结缔组织增生两者造成的重力和管壁收缩密切相关,亦构成与肺静脉干受侵时管腔闭塞、腔面模糊或消失征象的显著区别。

在国内外文献中,管周脂肪异常征象已被频繁引用为癌肿侵犯大血管的常见 CT、MRI 征象[7~15]。左、右肺动脉干均在心包外,周围被丰富的纵隔脂肪包绕,癌肿侵犯肺动脉干时,管周脂肪是必经途径,以此可以解释管周脂肪征象阳性率达 100.0 %。在 CT 组 15 例中,3 例以管周脂肪征阳性作为判断肺动脉干侵犯的惟一依据,该征象对早期发现肺癌 CIMPA 具有重要意义。

3.3 肺癌 CIMPA 分型在外科治疗中的意义 依据病理、CT 及 MRI 征象,本组将肺癌 CIMPA 分为相贴型及包埋型。由于两型在癌肿浸润深度上不存在显著性差异($P > 0.005$),因此将肺癌 CIMPA 分为相贴型及包埋型在判断癌肿侵犯范围及程度具有重要意义。手术结果显示,相贴型 10 例全部接受肺叶切除及袖状成型术,包埋型 13 例中行袖状成型术者仅占 30.7 %,全肺切除及不能手术切除者共达 69.2 %,表明将肺癌 CIMPA 分为两种类型在判断手术可能性、术式选择以及预后评估方面具有重要的意义。CT、MRI 征象与手术病理分型良好的相关性(Kappa 值分别为 0.61 及 0.84),提示该两种影像学检查可以作为诊断肺癌 CIMPA 的主要手段,其中 MRI 更为可靠。

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·启事·

致作者

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