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中耳胆脂瘤的影像诊断:高分辨率计算机断层成像与磁共振成像的比较研究

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摘要 目的:评估和比较高分辨率计算机断层成像(high resolution computer tomography, HRCT)与磁共振成像(magnetic resonance imaging, MRI)对中耳胆脂瘤的诊断价值。**方法:**回顾性分析临床初步诊断为中耳胆脂瘤患者 55 人(63 耳)在术前 5 天内进行的 16 排 HRCT 和 1.5T MRI 诊断结果,以病理诊断为基础对 HRCT 和 MRI 的诊断结果进行对比研究,统计分析 HRCT 和 MRI 的灵敏度、特异度、阳性预期值、阴性预期值,以及 Kappa 检验两者之间的内在观察一致性。**结果:**63 耳中,病理确诊为中耳胆脂瘤 40 耳。HRCT 正确诊断 30 例,假阳性 11 例,假阴性 10 例,灵敏度、特异度、阳性预期值以及阴性预期值分别为 75%、52.17%、73.17%、54.55%。MRI 正确诊断 37 例,假阳性和假阴性各为 3 例,灵敏度、特异度、阳性预期值以及阴性预期值分别为 92.5%、86.96%、75% 和 86.96%。HRCT 与 MRI 诊断结果之间的内在观察一致性 Kappa=0.274 (P<0.05)。剔除既往有手术史的 10 耳,只针对无手术史的 53 耳,HRCT 与 MRI 诊断结果之间的内在观察一致性增高,吻合度一般, Kappa=0.462 (P<0.05)。**结论:**MRI 的总体阳性检出率高于 HRCT,尤其是对中耳胆脂瘤手术后复发的诊断;HRCT 与 MRI 两者相结合对于中耳胆脂瘤的明确诊断具有互补作用。

关键词:中耳胆脂瘤;高分辨率 CT;磁共振成像

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Imaging Diagnosis of Middle Ear Cholesteatoma: Comparative Study on High Resolution Computed Tomography and Magnetic Resonance Imaging

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ABSTRACT Objective: To evaluate and compare the value of high resolution computed tomography (HRCT) and magnetic resonance imaging (MRI) in the diagnosis of middle ear cholesteatoma. **Methods:** Retrospectively analyzed 55 patients (63 ears) with clinically suspected middle ear cholesteatoma who received both 16-slice HRCT and 1.5T MR scanning within 5 days before operation. HRCT and MRI were compared based on pathology and performed statistical analysis. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) of HRCT and MRI were calculated and the inter-observer agreement between both was assessed with the kappa value. **Results:** Among 63 ears, 40 ears were diagnosed as middle ear cholesteatoma by pathology. By HRCT, 30 ears having middle ear cholesteatoma were identified correctly. The false positive was 11 and the false negative was 10. The sensitivity, specificity, PPV and NPV of HRCT were 75%, 52.17%, 73.17% and 54.55%, respectively. In contrast, 37 ears having middle ear cholesteatoma were identified correctly by MRI. Both the false positive and the false negative were 3. The sensitivity, specificity, PPV and NPV of MRI were 92.5%, 86.96%, 75% and 86.96%. The inter-observer agreement between HRCT and MRI was poor, Kappa=0.274 (P<0.05). Removing 10 post-operative ears, only for the 53 non-operated ears, the inter-observer agreement between HRCT and MRI raised, Kappa=0.462 (P<0.05). **Conclusion:** The total positive rate of MRI was higher than HRCT, especially for post-operative recurrence. The combination of HRCT and MRI had a complementary role in diagnosis of middle ear cholesteatoma.

Key words: Middle ear cholesteatoma; High-resolution CT; Magnetic resonance imaging

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前言

中耳胆脂瘤是中耳炎的独立类型之一^[1],青少年发病率高

于成人^[2],具有较强侵袭性、破坏骨质、易复发的特点,危害性较大。另外,中耳结构复杂且狭小,与众多血管、神经及其他重要结构相毗邻,因此中耳胆脂瘤可引起严重并发症^[3]。有文献报道中耳胆脂瘤和鳞癌有一定的关联,也就是说,中耳胆脂瘤有可能进展为鳞癌^[4]。

HRCT 是中耳胆脂瘤影像学检查的首选方法^[5]。但是,受限于 HRCT 的密度分辨率,其对中耳内的软组织影鉴别困难;对

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于中耳胆脂瘤术后复发的诊断和鉴别诊断,HRCT 亦不可靠^[6]。目前,MRI 扫描技术不断发展,尤其是弥散加权成像(diffusion-weighted imaging, DWI)和增强扫描的应用,使其对中耳胆脂瘤的灵敏度和特异度越来越高^[7]。本研究旨在通过对比 HRCT 和 MRI 来评估其临床应用价值。

1 材料与方法

1.1 研究对象

连续收集我院 2008 年 10 月至 2013 年 10 月,临床初步诊断怀疑为中耳胆脂瘤的患者 55 人,共 63 耳,男性 26 耳,女性 37 耳,年龄 16~85 岁,平均(53.5±17.5)岁,手术前 5 天内均进行 16 排 HRCT 和 1.5T MR 检查,手术后获得病理诊断。

1.2 设备及方法

1.2.1 CT 扫描方法 美国飞利浦医疗系统(克利夫兰公司)16 排螺旋 CT 扫描仪(Brilliance CT 16 Slice),患者仰卧位,平扫以听眦线(OM 线)为扫描基线,扫描范围由岩骨嵴至乳突尖下缘。冠状面 MPR 重建垂直于硬腭。骨算法重建,窗宽 4095HU,窗位 1000 HU,层厚 0.80mm,重建间隔 0.40mm。原始数据均在 Philips Extended Brilliance Workspace 工作站上进行 MPR 重建。

1.2.2 MRI 扫描方法 德国西门子医疗公司 1.5T 磁共振机(Avanto),头部八通道正交线圈。检查序列:T1WI-vibe 序列横断位容积扫描,层厚 1mm,TR=9ms,TE=2.38ms;T1WI-FSE 冠状位扫描,层厚 2mm,TR=631ms,TE=22ms;T2WI-FSE 冠状位扫描,层厚 2mm,TR=3711.6ms,TE=99ms;平面回波弥散加权成像(unenhanced echo-planar diffusion-weighted imaging, EPI-DWI),层厚 3mm,TR=3000ms,TE=90ms,b=800s/mm²,Tubo Factor=144;静脉注入 Gd-DTPA 30ml,注射速率 2.5ml/s,立即行 T1WI-vibe 序列横断位容积扫描,层厚 1mm,TR=7.5ms,TE=2.38ms;T1WI-FSE 抑脂序列冠状位扫描,层厚 2mm,TR=513ms,TE=11ms;增强后延迟 30 分钟,再重复上述 2 个序列扫描一次。

1.2.3 图像分析 影像资料均传输至 GE 医疗公司的 PACS 系统,采用盲法由两名有 5 年相关工作经验的高年资影像科医师观察 HRCT 或 MRI 图像,得出 CT 或 MR 诊断结果,意见不统一时协商解决。

1.3 中耳胆脂瘤诊断标准

1.3.1 HRCT 诊断标准 中耳内见软组织密度影及骨质破坏,包括:盾板破坏;有软组织充填的扩大的上鼓室;软组织包裹的听小骨移位;有软组织充填的边缘清楚的扩大骨腔隙;中耳结构骨组织的破坏及硬化型乳突等表现,可侵袭外耳道、中耳、乳

突以及颞骨邻近的重要解剖结构(听小骨、半规管、面神经管、颅底脑板、乙状窦、颞颌关节等)。

1.3.2 MRI 诊断标准 病灶 DWI(b=800s/mm²)呈明显高信号影;T1WI 平扫呈等低信号影,增强扫描无强化或周边强化、中央无强化,增强延迟扫描中央仍无强化^[8,9]。

1.3.3 病理诊断标准 中耳胆脂瘤是一种囊性结构,由过度角化的鳞状上皮构成囊壁,产生角蛋白的鳞状上皮组织在中耳、乳突内生长,脱落上皮异常堆积,囊内充满了层状的角化物、脱落上皮、胆固醇结晶与碎屑状物及炎性渗出物^[10](图 1)。中耳胆脂瘤特指后天性胆脂瘤,不包括先天性胆脂瘤^[11]。

1.4 统计学分析

采用 SPSS19.0 软件包,分别得出 HRCT 诊断结果和 MRI 诊断结果的灵敏度、特异度、阳性预期值和阴性预期值,并将 HRCT 诊断结果与 MRI 诊断结果进行配对,采用卡方检验方法,计算二者之间内在观察一致性 Kappa 值。再剔除有手术史的患耳,只针对无手术史的 53 例患耳,得出 HRCT 与 MRI 之间的 Kappa 值。Kappa 值大于或等于 0.75 为两者吻合度较高,0.4~0.75 为吻合度一般,小于 0.4 为吻合度较差。检验标准以 P<0.05 表示差异有统计学意义。

2 结果

2.1 HRCT 诊断结果

63 耳中,病理确诊为中耳胆脂瘤 40 例,HRCT 正确诊断 30 例,灵敏度为 75%,特异度为 52.17%,阳性预期值为 73.17%,阴性预期值为 54.55%(表 1)。HRCT 典型表现为中耳内膨胀性生长的软组织病灶、鼓膜内陷、鼓室盾板变钝、鼓室顶盖及听小骨骨质破坏(图 2A)。

2.2 MRI 诊断结果

40 例病理确诊为中耳胆脂瘤的病例中,MRI 正确诊断 37 例。灵敏度为 92.5%,特异度为 86.96%,阳性预期值为 75%,阴性预期值为 86.96%(表 2)。MRI 典型表现为 DWI 中耳病灶明显高信号影;T1WI 增强扫描无强化或周边强化、中央无强化,增强延迟扫描中央仍无强化;常规序列没有特异性:T1WI 呈低信号或等信号,T2WI 呈高信号或等信号(图 2B~F)。

2.3 HRCT 与 MRI 二者之间内在观察一致性

经统计学分析,HRCT 与 MRI 诊断中耳胆脂瘤的差别有统计学意义 P<0.05 (P=0.029),但是两者之间的吻合度较差,Kappa=0.274(表 3)。

剔除既往有手术史的 10 耳,只针对无手术史的 53 耳,HRCT 与 MRI 诊断结果之间的内在观察一致性增高,吻合度一般,Kappa=0.462 (P=0.01<0.05)(表 4)。

表 1 HRCT 诊断结果与病理对照
Table 1 Comparison of HRCT diagnoses and pathology

		Pathology		total
		middle ear cholesteatoma	others	
HRCT diagnoses	Middle ear cholesteatoma	30	11	41
	others	10	12	22
Total		40	23	63

Sensitivity=75%, specificity=52.17%, PPV=73.17%, NPV=54.55%

表 2 MRI 诊断结果与病理对照
Table 2 Comparison of MRI diagnoses and pathology

		pathology		Total
		Middle ear cholesteatoma	Others	
MRI diagnoses	Middle ear cholesteatoma	37	3	40
	others	3	20	23
	Total	40	23	63

Sensitivity=92.5%, specificity=86.96%, PPV=75%, NPV=86.96%.

表 3 HRCT 诊断结果与 MRI 诊断结果对照
Table 3 Comparison of HRCT diagnoses and MRI diagnoses

		MRI diagnoses		Total
		Middle ear cholesteatoma	Others	
HRCT diagnoses	Middle ear cholesteatoma	30	11	41
	others	10	12	22
	Total	40	23	63

The Kappa value of the inter-observer agreement between HRCT and MRI=0.274 (P=0.029<0.05)

表 4 无手术史病例的 HRCT 诊断结果与 MRI 诊断结果对照
Table 4 Comparison of HRCT diagnoses and MRI diagnoses for non-operated cases

		MRI diagnoses		Total
		Middle ear cholesteatoma	Others	
HRCT diagnoses	Middle ear cholesteatoma	28	8	36
	others	5	12	17
	Total	33	20	53

The Kappa value of the inter-observer agreement between HRCT and MRI=0.462 (P=0.01<0.05).



图 1 中耳胆脂瘤 HE 染色(× 100):过度角化的鳞状上皮构成囊壁(↑)
Fig. 1 HE staining of middle ear cholesteatoma (× 100): the cystic lesion covered by the strongly keratinizing squamous epithelium (↑)

3 讨论

3.1 HRCT 诊断中耳胆脂瘤的优劣势

HRCT 具有良好的空间分辨率,可以观察到中耳胆脂瘤的典型表现^[12]。随着计算机技术的不断发展,多排螺旋 CT 后处理技术对中耳胆脂瘤的诊断有重要参考价值。MPR 可以多角度、

任意平面观察病灶。VR 可以直观、立体的显示听小骨和耳蜗,清晰反映听骨链骨质破坏情况。但是,不可忽视 HRCT 横断位的高分辨率图像,因为它是以上重建方法的基础,必须两者相结合^[13]。

HRCT 对中耳胆脂瘤的特异度较差,因为中耳胆脂瘤、中耳炎性肉芽组织、分泌物、胆固醇肉芽肿以及肿瘤在 CT 上的表现相似,均表现为中耳内软组织密度影及骨质边缘模糊、吸收^[14]。本研究,HRCT 特异度为 52.17%,与文献一致。其中,因化脓性中耳炎导致 HRCT 假阴性 2 例、假阳性 5 例;胆固醇性肉芽肿导致 1 例 HRCT 假阳性;因肿瘤(鳞癌)导致 HRCT 假阴性 1 例,假阳性 3 例。

有无骨质破坏及病灶位置在一定程度上有助于鉴别病灶的病理类型^[7]。但是,骨质破坏应用于中耳胆脂瘤的鉴别有一定的局限性。手术证实 CT 发现骨质破坏的准确率在 50%-97%^[12]^[15,16]。覆盖于面神经的骨质,即中耳后壁(乳突壁)很薄,CT 不能清晰显示^[17]。因此没有发现骨质破坏并不能完全排除中耳胆脂瘤,特别是在病灶很小的时候。本研究,因未发现骨质破坏而导致 HRCT 假阴性 3 例,其中 1 例病灶小于 2 mm。

中耳胆脂瘤手术史对 HRCT 诊断中耳胆脂瘤复发的影响很大。既往中耳胆脂瘤及手术会破坏中耳骨质,导致骨质缺损,引起中耳乳突骨壁结构变化。手术后中耳内也可能存在纤维疤

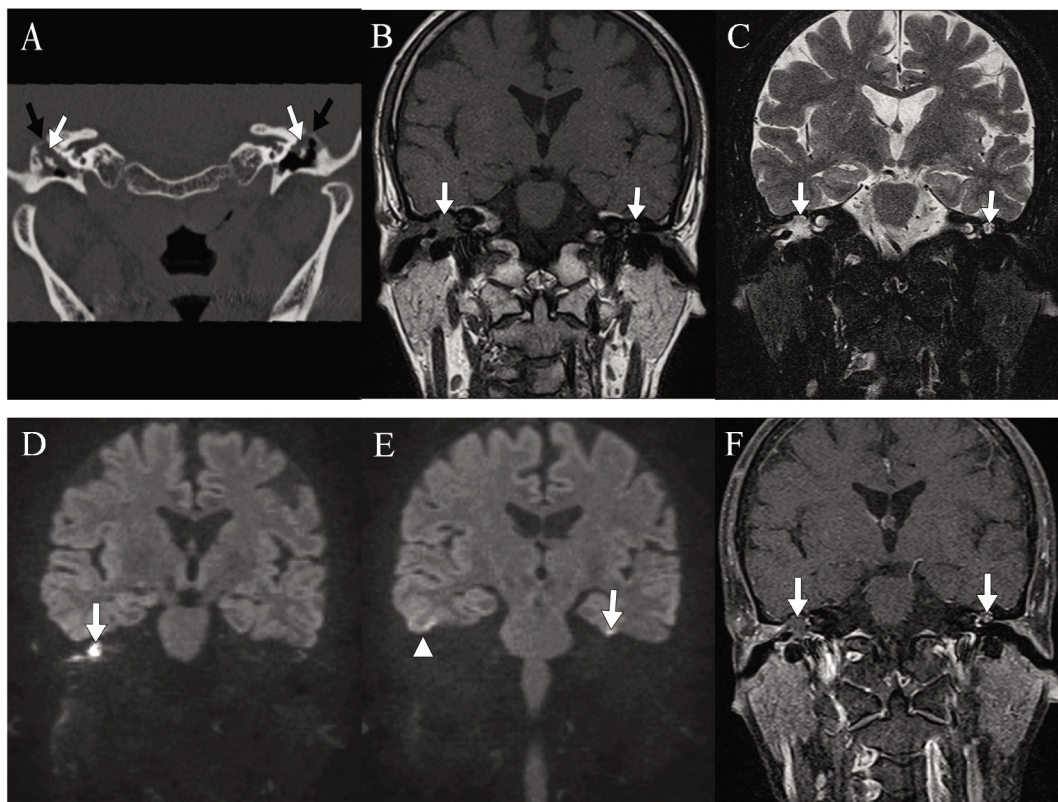


图1 64岁男性双耳胆脂瘤患者。HRCT冠状位MPR重建(A)示双侧中耳内膨胀性生长的软组织病灶(↑),鼓室盾板变钝,听小骨骨质破坏,鼓室顶盖骨质破坏(↑)。MR T1WI(B)示双侧中耳胆脂瘤(↑)为等信号,T2WI(C)为等高混杂信号,EPI-DWI(D、E)为高信号,注意EPI-DWI(E)易形成颅底骨与空气交界面的伪影(△),T1WI延迟增强扫描(F)示右侧中耳胆脂瘤无强化,左侧中耳胆脂瘤病灶中央无强化,周围肉芽组织明显强化

Fig. 1 A 64 years old male patient with middle ear cholesteatoma in both ears. The MPR coronal reconstruction of HRCT image (A) shows expansile soft-tissue lesion in both middle ears(↑), scutum blunting, erosion of the tympanic ossicles and tegmen(↑). MR T1WI (B) shows iso-intense of middle ear cholesteatoma (↑). T2WI (C) shows a mixture of iso-intense and hyper-intense. EPI-DWI (D、E) shows hyper-intense. Note the artifacts (△) of EPI-DWI (E) at air/bone interfaces at the skull base. Delayed contrast-enhanced T1WI (F) indicates the non-enhancing right middle ear cholesteatoma and differentiates the non-enhancing left middle ear cholesteatoma in the center of the lesion from the strongly enhancing granulation tissue around the lesion

痕、肉芽组织。这些都给HRCT对中耳胆脂瘤复发的诊断和鉴别诊断带来困难。本研究HRCT灵敏度为75%,与文献比较偏低,考虑可能是因为收集了10例既往有中耳胆脂瘤手术史的病例,其中4例导致HRCT假阴性,2例导致HRCT假阳性。

3.2 MRI诊断中耳胆脂瘤的优劣势

MRI具有良好的密度分辨率,对黏膜肥厚、积液的显示较敏感。DWI对诊断中耳胆脂瘤有较高价值^[18,19]。中耳胆脂瘤在DWI上表现为高信号^[20]。对中耳胆脂瘤,仅依靠DWI高信号就可以达到较高的灵敏度和特异度^[21]。有文献报道,DWI序列的应用可以防止不必要的二次探查手术^[22,23]。

T1WI增强扫描有助于鉴别中耳胆脂瘤和肉芽组织、肿瘤等病变^[24],因为肉芽组织、肿瘤等病变有强化,而中耳胆脂瘤无强化。本研究中,4例病理证实为鳞癌的病例,MRI均正确诊断,而HRCT只正确诊断1例;14例炎性肉芽组织和2例胆固醇肉芽肿,MRI亦全部正确诊断。

MRI常规序列对中耳胆脂瘤没有特异性。炎性肉芽组织、手术后的疤痕组织、出血以及含蛋白渗出液与中耳胆脂瘤在T1WI和T2WI上信号相似。

本研究运用的是平面回波弥散加权成像(EPI-DWI)。EPI-DWI对磁场较敏感,在颅底骨与空气交界面易形成的伪影

^[25]。本研究中,2例假阳性和2例假阴性均由于对颅底骨-气交界面伪影认识不够引起。经回顾总结,骨-气交界面伪影大多数边缘锐利的高信号影,中耳胆脂瘤为片状、边缘柔和的高信号影。此外,EPI-DWI扫描层厚较厚,1.5T MR机器上最薄层厚3 mm。本研究中1例假阴性即由病灶小于2 mm所致。这与一些文献报道相符,DWI对小于2~3 mm的中耳胆脂瘤易漏诊^[20,26]。

3.3 HRCT诊断中耳胆脂瘤与MRI诊断中耳胆脂瘤的吻合度

对HRCT与MRI两者之间内在观察一致性统计分析,两者的吻合度较差。分析发现,HRCT与MRI吻合度较差的主要原因是HRCT对中耳胆脂瘤术后复发鉴别困难。10例既往患耳有手术史的病例中,有8例HRCT和MRI的诊断不吻合:其中6例HRCT诊断错误,均是因为对软组织影和骨质破坏缺损判断错误引起;2例MRI诊断错误,均是因为对颅底骨-气交界面伪影判断错误引起。因此,剔除既往有手术史的10耳,只针对无手术史的53耳,HRCT与MRI之间的内在观察一致性增高,吻合度一般。此外,还有13例HRCT和MRI的诊断不吻合:包括3例鳞癌、3例炎性肉芽肿、1例胆固醇肉芽肿,6例中耳胆脂瘤。这13例中,除了1例中耳胆脂瘤MRI诊断错误(DWI高信号误认为伪影),其余12例MRI均诊断正确。

综上所述,中耳胆脂瘤的影像检查,HRCT 是最常用和首选方法,而 MRI 的灵敏度、特异度和总体阳性检出率均高于 HRCT,尤其是对中耳胆脂瘤手术后复发的诊断,因此 HRCT 与 MRI 两者相结合对于中耳胆脂瘤的明确诊断具有互补作用。

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