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预测原发性脑出血患者发生血肿扩大的影像学特征

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【摘要】 原发性脑出血(sICH)是一种常见的神经系统疾病, 占卒中患者总数的10%~15%, 其首次发病后出现血肿扩大的概率超过30%。血肿扩大是sICH患者最严重的并发症之一, 其出现预示着患者神经功能恶化和预后不良, 如能早期预测血肿扩大并采取针对性的治疗措施, 对降低sICH患者致死率、致残率具有重要意义。本文主要综述了可预测sICH患者发生血肿扩大的CT影像学特征、CTA影像学特征及影像组学, 以期对sICH患者发生血肿扩大的预测提供一定帮助。

【关键词】 脑出血; 原发性脑出血; 血肿扩大; 影像学特征; 预测; 综述

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Imaging Features for Predicting Hematoma Enlargement in Patients with Spontaneous Intracerebral Hemorrhage WU

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【Abstract】 Spontaneous intracerebral hemorrhage (sICH) is a common neurological disease, accounting for 10%–15% of the total number of stroke patients, and the probability of hematoma enlargement after the first onset is more than 30%. Hematoma enlargement is one of the most serious complications in patients with sICH, which indicates the deterioration of neurological function and poor prognosis. If hematoma enlargement can be predicted early and taken targeted treatment measures, it is of great significance to reduce the mortality and disability rate of sICH patients. This article reviews the CT imaging features, CTA imaging features and radiomics of predicting hematoma enlargement in patients with sICH, in order to provide some help for the prediction of hematoma enlargement in patients with sICH.

【Key words】 Intracranial hemorrhage; Spontaneous intracerebral hemorrhage; Hematoma enlargement; Imaging features; Forecasting; Review

原发性脑出血(spontaneous intracranial hemorrhage, sICH)简称脑出血, 属于严重神经系统疾病, 占卒中患者总数的10%~15%, 且其死亡率、致残率均较高^[1-3]。研究表明, sICH患者早期血肿扩大发生率高达30%, 发病6 h内血肿扩大发生率为13%~38%, 发病24 h后血肿扩大很少见^[4-5]。2020年, 《高血压性脑出血中国多学科诊治指南》^[6]推荐, 接诊疑似脑出血的患者后应尽快行CT检查以明确sICH诊断(I级推荐, A级证据)。目前, 预测血肿扩大的影像学特征较多, 其预测价值也存在较大差异。本文主要综述了可预测sICH患者发生血肿扩大的CT影像学特征、CTA影像学特征及影像组学, 以期对sICH患者发生血肿扩大的预测提供一定帮助。

1 CT影像学特征

1.1 “岛征” LI等^[7]首次提出“岛征”这一征象, 并发现“岛征”是预测血肿扩大的独立影响因素。分析“岛征”

可以预测血肿扩大的机制可能如下: 血肿内部压力很大, 破裂血管正好成为降低内部压力的缺口; 血肿周边水肿对破裂小血管的压迫止血能力降低, 从而引起邻近小血管活动性出血^[7]。多项研究表明, “岛征”可以预测sICH患者不良预后^[8-10]。王希等^[11]研究发现, “岛征”联合其他影像学特征可以辅助临床预测sICH患者发生早期血肿扩大。“岛征”是一个基于CT平扫的影像学特征, 其可以直观反映血肿形态的不规则性, 而不规则的血肿是成熟血肿的某一必经阶段。

1.2 “卫星征” “卫星征”是反映血肿形态不规则性的另一个简单的影像学特征。SHIMODA等^[12]研究发现, “卫星征”是sICH患者不良预后的独立危险因素。伴有“卫星征”的sICH患者多合并较大的初始血肿量^[13]。研究发现, “卫星征”对sICH患者发生血肿扩大的预测价值高于其他影像学特征^[14]。

1.3 “旋涡征” “旋涡征”被认为是血肿密度不均匀的早期表现^[15]。PARK等^[16]研究发现, “旋涡征”诊断颅内出血扩大的阳性率为39%, 其是由颅内持续出血所致, 故与患者不良预后相关。研究表明, 出现“旋涡征”的颅内出血患者血肿体积增大更明显, 且其与患者初始血肿体积、早期血

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肿扩大有关^[17]。“旋涡征”是预测血肿扩大的一个重要影像学特征,且与患者预后不良及死亡有一定关系。

1.4 “黑洞征” “黑洞征”与“旋涡征”有重叠。“黑洞征”被认为是血肿内密度不均匀,存在高、低密度影,其中低密度影边界清楚,包裹在血肿内,与周围脑实质至少有28 HU的差异,且低密度影形态各异^[18]。XIONG等^[18]研究发现,“黑洞征”能够独立预测sICH患者发生早期血肿扩大。LI等^[19]研究发现,sICH发病6 h内16.7%的患者出现了“黑洞征”。毛益光等^[20]及HE等^[21]研究显示,“黑洞征”是sICH患者发生血肿扩大的独立影响因素。因此,“黑洞征”对sICH患者发生早期血肿扩大具有一定预测作用。

1.5 “混合征” 国外学者发现,“混合征”可能是sICH的治疗靶点^[22]。研究表明,“混合征”预测sICH患者发生血肿扩大的灵敏度为28%、特异度为92%^[23],且其能独立预测ICH患者3个月的不良预后^[24]。LI等^[25]研究发现,由“混合征”和“黑洞征”构建的模型对sICH患者发生早期血肿扩大具有较好的预测价值。

1.6 “低密度征” “低密度征”定义为血肿内的低密度区域,其形态与大小无特殊差异,与周围脑实质分离,边界清楚或不清楚^[26]。大量研究表明,“低密度征”预测sICH患者发生血肿扩大的灵敏度为62%、特异度为77%、阳性预测值为40%、阴性预测值为89%^[27-28]。“低密度征”是sICH患者发生血肿扩大新的预测因子^[29]。

1.7 血肿内液体水平 血肿内液体水平定义为在脑出血凝固过程中,血浆与凝固的血液随时间先后顺序沉淀而形成的一种分层现象。血肿内液体水平在血肿扩大患者中出现的概率较低,但有研究表明,血肿内液体水平与血肿早期扩大和不良预后有关^[30-31]。伴有凝血功能障碍的脑出血患者易出现血肿内液体水平,该特征与脑实质出血位置相关,也可能与止血不充分致使高密度脂蛋白早期渗漏有关^[32]。目前,有关血肿内液体水平的文献较少,其对sICH患者发生血肿扩大的预测价值有限。

2 CTA影像学特征

2.1 “点征” “点征”定义为血肿范围内出现超过一个斑点状或小点片状增强病灶(一般最大径 ≥ 1 mm且 < 5 mm),形态及大小无特异性,与周围血肿的CT值相差 > 120 HU,与血肿的脉管系统完全中断^[33]。“点征”出现的病理机制尚未明确,可能与小血管破裂未完全修复,进而出现造影剂外溢有关。研究表明,“点征”是脑出血患者发生早期血肿扩大与预后不良的独立预测因素^[34-35],其预测脑出血患者发生早期血肿扩大的灵敏度为63%、特异度为90%、阳性预测值为73%、阴性预测值为84%^[35]。MOROTTI等^[36]研究发现,基于高管电流获得的CTA图像“斑点征”可以更好地预测血肿扩大。邓喜青等^[37]认为,双能量CTA较常规CTA对颅内血肿扩大的预测价值更高。“点征”联合“混合征”可以提高对脑出血患者发生血肿扩大的预测效能^[38]。此外,“点征”作为中等量基底核脑出血患者超早期外科手术的客观指标之一,可明显提高患者的生存率^[39]。《高血压性脑出血中国多学科诊治指南》^[6]建议,有条件的医疗机构应对高血压脑出血患

者行常规CTA检查(Ⅱa级推荐,A级证据),其中“点征”是患者血肿扩大风险高的重要依据(Ⅱ级推荐,B级证据)。

基于“点征”,研究者又做了进一步拓展。CT灌注成像显示,血肿扩大更易发生于高灌注区,“动态斑点征”是早期血肿扩大和不良预后的独立预测因子,其灵敏度高于CTA成像“点征”^[40]。此外,“延迟点征”对血肿扩大的预测价值也高于CTA成像“点征”^[41]。

2.2 “点征”的特殊类型

2.2.1 “渗漏征” ORITO等^[42]于2016年首次提出“渗漏征”,并发现“渗漏征”是sICH患者不良预后及发生血肿扩大的关键影像学特征和预测因素。“渗漏征”能独立预测sICH患者发生血肿扩大,其灵敏度、特异度均高于“点征”^[43-44]。“渗漏征”可视为“点征”的一个特殊类型,其提示造影剂外溢的范围更大、浓度更高,故对血肿扩大的预测价值亦更高。

2.2.2 “点尾征” “点尾征”是“点征”的另一个特殊类型。SORIMACHI等^[45]研究发现,3例出现“点尾征”的脑出血患者均发生了早期血肿扩大;“点尾征”是由造影剂外渗所致,而纹状动脉供血于基底核区,故“点尾征”可能对基底核区血肿扩大的预测价值更高。

2.3 “碘征”及“充血征” “碘征”是基于宝石能谱CT检查显示的,其预测血肿扩大的灵敏度及正确率均高于“点征”^[46]。“充血征”是预测sICH患者发生血肿扩大和死亡的独立危险因素^[47]。目前,国内宝石能谱CT及双源CT价格昂贵,尚未得到普及,故关于上述两个影像学特征的研究很少,未来其可能成为研究热点。

3 影像组学

影像组学预测血肿扩大是基于CT图像的组学特征及纹理特征,是现阶段的研究热点^[48-51]。既往一项研究利用LASSO回归模型筛选出11个影像组学特征并构成影像组学标签,结果发现其对sICH患者发生血肿扩大具有较好的预测价值^[48],SHEN等^[49]研究也得出了相似结论。CHEN等^[50]研究发现,影像组学-临床模型较单纯临床模型对血肿扩大的预测价值更高,其预测血肿扩大的AUC为0.820。陈媛媛等^[51]研究也表明,临床-影像组学联合模型能够有效地预测sICH患者早期血肿扩大且具有良好的校准度,有助于临床个体化评估sICH患者发生早期血肿扩大的风险。

4 小结

血肿扩大是sICH患者最严重的并发症之一,其出现预示着患者神经功能恶化和预后不良,如能早期预测血肿扩大并采取针对性的治疗措施,对降低sICH患者死亡率、致残率具有重要意义。上述研究表明,CT、CTA影像学特征及影像组学均能有效预测sICH患者发生血肿扩大,这对改善sICH患者预后及降低其病死率具有重要临床意义。

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