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脑血管畸形破裂出血的影响因素及受试者工作特征曲线预测价值分析*

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摘要 目的:探讨脑血管畸形破裂出血的影响因素,并进行受试者工作特征(ROC)曲线分析。**方法:**回顾性分析我院 2015 年 6 月至 2018 年 1 月收治的 138 例脑血管畸形患者的临床资料,根据患者是否并发破裂出血,将其分为出血组($n=76$)和未出血组($n=62$)。采用单因素和多因素 Logistic 回归分析法对两组患者的临床资料进行研究,并采用 ROC 曲线评价各影响因素对脑血管畸形破裂出血的预测价值。**结果:**两组患者在与畸形血管团位置关系、是否合并硬脑膜动静脉瘘、合并动脉瘤数目、合并动脉瘤大小、合并瘤样变、供血动脉位置、引流静脉方向以及畸形血管团大小方面差异具有统计学意义($P<0.05$)。多因素 Logistic 回归分析结果显示,引流静脉方向、畸形血管团大小以及合并动脉瘤数目是脑血管畸形破裂出血的独立危险因素($P<0.05$)。引流静脉方向的 ROC 曲线下面积为 0.921,特异度和灵敏度分别为 0.832 和 0.801,是三种影响因素中预测价值最高的,其次是合并动脉瘤数目和畸形血管团大小。**结论:**合并动脉瘤、引流静脉方向以及畸形动脉血管团大小是脑血管畸形破裂出血的重要危险因素,且对脑血管畸形破裂出血具有一定的预测价值,可为脑血管畸形破裂出血的预防诊治提供参考。

关键词:脑血管畸形;破裂出血;畸形血管团大小;引流静脉方向;ROC 曲线

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Influencing Factors of Ruptured Hemorrhage of Cerebrovascular Malformation and Predictive Value of ROC Curve*

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ABSTRACT Objective: To explore the influencing factors of ruptured hemorrhage of cerebrovascular malformation and to analyze the ROC curve of subjects. **Methods:** The clinical data of 138 patients with cerebrovascular malformation admitted to our hospital from June 2015 to January 2018 were retrospectively analyzed. According to whether the patient had concurrent rupture, they were divided into hemorrhage group ($n=76$) and non-bleeding group ($n=62$). The clinical data of the two groups were studied by single factor and multivariate logistic regression analysis. The ROC curve was used to evaluate the predictive value of various influencing factors on cerebral vascular malformation rupture. **Results:** There were statistically significant differences between the two groups in the relationship with the location of malformed blood vessels, whether dural arteriovenous fistula was combined, the number of aneurysms, the size of aneurysms, the size of aneurysms, the location of blood supply arteries, the direction of drainage veins, and the size of malformed blood vessels ($P<0.05$). Multivariate logistic regression analysis showed that the direction of drainage vein, the size of malformed vascular mass and the number of aneurysms were independent risk factors for cerebral vascular malformation ($P<0.05$). The area under the ROC curve in the direction of the drainage vein was 0.921, and the specificity and sensitivity were 0.832 and 0.801, respectively, which were the highest predictive value among the three influencing factors, followed by the number of aneurysms and the size of the deformed vascular mass. **Conclusion:** The combination of aneurysm, drainage vein and abnormal vascular mass is an important risk factor for cerebral vascular malformation rupture, and it has certain predictive value for cerebral vascular malformation rupture, which can provide reference for the prevention and treatment of cerebral vascular malformation rupture.

Key words: Cerebral vascular malformation; Rupture hemorrhage; Size of malformed vascular mass; Direction of drainage vein; ROC curve

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前言

脑血管畸形是一种由胚胎期颅内血管异常发育引起的脑血管疾病,其通常表现出一系列的临床体征以及症状,这可能

是由于患者脑动脉静脉血管之间起连接作用的毛细血管相对缺乏,进而发生短路现象,造成其颅内血管血流动力学发生一定程度的紊乱^[1]。有研究显示,脑血管畸形患者大约有 60% 的概率出现血管破裂出血,同时还具有不低于 30% 的病死亡率^[2]。脑血

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管畸形破裂出血患者一般多发生于青少年阶段,具有发病急,病情进展快的特点^[3]。出血后通常会由于占位效应对机体脑组织产生直接性的损伤,致使血肿周边的脑组织发生细胞性水肿和缺血,也是引起患者颅内自发性出血的重要原因之一,如不进行及时治疗,可给患者带来较差的预后^[4]。而近年,随着我国医学影像技术的跟进发展,脑血管畸形的临床诊断率具有一定程度的提高,致死致残率有所下降,但仍不理想^[5]。最大限度的脑组织损伤进行降低和切除畸形血管团是目前脑血管畸形治疗的主要准则,但是仍然不能保证术后不发生再出血^[6]。对其术后再出血进行预测也一直是临床研究热点。目前临床上对于畸形血管团的形态学以及血流动力学已经做过一定的研究,其可以增加再出血风险,但是否伴有瘤样改变、供血动脉的位置等

对于再出血的影响研究较为欠缺^[7,8]。故本文探讨脑血管畸形破裂出血与畸形血管团大小、引流静脉方向的相关性以及 ROC 曲线预测价值,为其临床诊治提供参考。

1 资料与方法

1.1 一般资料

回顾性分析我院 2015 年 6 月至 2018 年 1 月收治的 138 例脑血管畸形患者的临床资料,所有患者均给予全脑血管造影,出血标准参考血管造影之前的 CT 结果进行确定。根据患者是否并发破裂出血,将其分为出血组 (n=76) 和未出血组 (n=62)。两组患者一般资料方面差异不具有统计学意义,具有可比性 ($P>0.05$),见表 1。

表 1 两组患者基线资料比较

Table 1 Comparison of baseline data between the two groups of patients

Clinical data	Hemorrhage group (n=76)	No bleeding group (n=62)	t/χ^2	P
Male/female	48/28	39/23	0.001	0.975
Age(years)	5-58	5-56	-	-
Average age (years)	31.26± 5.28	31.53± 6.19	0.276	0.391
Lesion site [n(%)]				
Brain stem	3(3.95)	2(3.23)	0.210	0.995
Carcass	4(5.26)	3(4.84)		
Cerebellum	5(6.58)	3(4.84)		
thalamus	6(7.89)	4(6.45)		
Basal ganglion	6(7.89)	5(8.06)		
Occipital lobe	10(13.16)	8(12.90)		
Temporal lobe	11(14.47)	9(14.52)		
Parietal lobe	10(13.16)	7(11.29)		
Frontal lobe	21(27.76)	18(28.57)		
Medical history [n(%)]				
Irregular headache history	18(23.68)	14(22.22)	0.013	0.994
Hypertension	16(21.05)	13(20.63)		
Epilepsy	6(7.89)	5(7.94)		

1.2 方法

选择以下血管构筑特征作为研究项目:有无合并瘤样变、是够合并硬脑膜动脉瘘、所合并动脉瘤的大小和数目、与畸形血管团位置关系、合并动脉瘤数目、引流静脉方向和数目、供血动脉位置、畸形血管团位置和大小。本研究中,合并瘤样变分为是和否;是够合并硬脑膜动脉瘘分为是和否;所合并动脉瘤的大小分为 $\geq 5\text{ mm}$ 和 $<5\text{ mm}$,数目分为 1 和 ≥ 2 ;引流静脉数目分为 >5 条、3-4 条、 ≤ 2 条;深部引流方向为向下矢状窦、大脑以及横窦大静脉引流,浅部引流方向为向上吻合横窦引流、上矢状窦、矢状窦引流,两者皆为双向;供血动脉为后颅窝、脉络膜、穿支处的血管未深部,供血动脉位于大脑后、中以及前动脉的皮质支为浅部,两者皆有的为混合;畸形血管团主体位于大脑半球为浅部病变,位于小脑、脑干、脑室内、基质核区、丘脑为

深部病变;畸形血管团大小可分为 $>4\text{ cm}$ 、1-4 cm 和 $<1\text{ cm}$ ^[9,10]。

1.3 统计学分析

采用统计学专用软件 SPSS 20.00 对上述资料进行整理分析,其中计量资料采用 $(\bar{x}\pm s)$ 表示,行 t 检验;计数资料采用[例(%)]表示,行卡方检验;采用单因素和多因素 Logistic 回归分析脑血管畸形破裂出血的相关影响因素,并以 ROC 曲线分析评价各影响因素对脑血管畸形破裂出血的预测价值,当 $P<0.05$ 时数据差异具有统计学意义。

2 结果

2.1 脑血管畸形破裂出血的相关影响因素的单因素分析

两组患者在与畸形血管团位置关系、是否合并硬脑膜动脉瘘、合并动脉瘤数目、合并动脉瘤大小、合并瘤样变、供血动

脉位置、引流静脉方向以及畸形血管团大小方面差异具有统计学意义($P<0.05$),见表2。

表2 脑血管畸形破裂出血的相关影响因素的单因素分析 [n(%)]

Table 2 Univariate analysis of related factors affecting cerebral vascular malformation rupture [n(%)]

Influencing factors		Hemorrhage group (n=76)	No bleeding group (n=62)	t/χ^2	P
Positional relationship with malformed vascular mass	Distant part	17(22.37)	12(19.35)	7.167	0.028
	Blood supply artery end	24(31.58)	33(53.23)		
	Proximal vascular mass	35(46.05)	17(27.42)		
Whether combined with dural arteriovenous fistula	Yes	25(32.89)	6(9.68)	10.567	0.001
	no	51(67.11)	56(90.32)		
Number of aneurysms	1	26(34.21)	38(61.29)	10.069	0.002
	≥ 2	50(65.79)	24(38.71)		
Combined aneurysm size	<5 mm	17(22.37)	1(1.61)	12.969	0.000
	≥ 5 mm	10(13.16)	3(4.84)		
Combined tumor-like change	Yes	45(59.21)	14(22.58)	18.719	<0.001
	no	31(40.79)	48(77.42)		
Number of drainage veins	>5	9(11.84)	7(11.29)	5.298	0.071
	3-4	25(32.89)	32(51.61)		
	≤ 2	42(55.26)	23(37.10)		
Blood supply artery location	Deep	42(55.26)	6(9.68)	34.153	<0.001
	Shallow	24(31.58)	48(77.42)		
	mixing	10(13.16)	8(12.90)		
	Shallow	21(27.63)	38(61.29)		
Drainage vein direction	Two way	42(55.26)	18(29.03)	15.820	0.001
	Deep	13(17.11)	6(9.68)		
Malformed vascular mass position	Deep	46(60.53)	38(61.29)	0.008	0.927
	Shallow	30(39.47)	24(38.71)		
Malformed vascular mass	>4 cm	25(32.89)	22(35.48)	13.138	0.001
	1-4 cm	30(39.47)	37(59.68)		
	<1 cm	21(27.63)	3(4.84)		

表3 脑血管畸形破裂出血的相关影响因素的多因素 Logistic 回归分析

Table 3 Multivariate logistic regression analysis of related factors influencing cerebral vascular malformation rupture

Influencing factors	β	SE	Wald	OR	P	95%CI
Drainage vein direction	0.579	0.231	5.987	1.791	0.028	1.120-2.914
Malformed vascular mass	0.230	0.103	8.912	1.262	0.040	1.021-1.576
Number of aneurysms	0.816	0.409	3.975	2.254	0.016	1.012-5.055

2.2 脑血管畸形破裂出血的相关影响因素的多因素 Logistic 回归分析

对脑血管畸形破裂出血的相关影响因素进行多因素 Logistic 回归分析结果显示,引流静脉方向、畸形血管团大小以及合并动脉瘤数目是脑血管畸形破裂出血的独立危险因素($P<0.05$),见表3。

2.3 各影响因素预测脑血管畸形破裂出血的受试者 ROC 曲线分析

引流静脉方向的 ROC 曲线下面积为 0.921,特异度和灵敏度分别为 0.832 和 0.801,是三种影响因素中预测价值最高的,其次是合并动脉瘤数目和畸形血管团大小,见表4和图1。

3 讨论

表 4 各影响因素预测脑血管畸形破裂出血的受试者 ROC 曲线分析

Table 4 Analysis of ROC curves of subjects with predictors of cerebral vascular malformation rupture

Influencing factors	Specificity	Sensitivity	Area under the curve
Drainage vein direction	0.832	0.801	0.921
Number of aneurysms	0.823	0.714	0.725
Malformed vascular mass	0.724	0.656	0.669

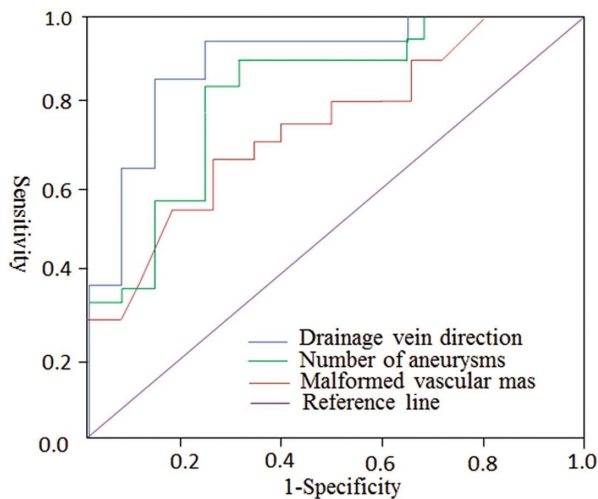


图 1 各影响因素预测脑血管畸形破裂出血的受试者 ROC 曲线

Fig.1 ROC curves of subjects with predictors of cerebral vascular malformation rupture

本文多因素 Logistic 回归研究结果提示,脑血管畸形破裂出血的保护性因素为畸形血管团变大,而深部静脉引流以及合并动脉瘤是其发生出血的促进性因素。目前临床对于脑血管畸形破裂出血与其是否合并动脉瘤之间的关系尚未有权威性定论^[11,12]。Chen J 等^[13]人研究显示,为合并有动脉瘤的脑动脉畸形患者的出血率为 1.7%,明显低于合并动脉瘤出血者。但未有其他相关研究提示动脉瘤会提高患者出血的风险^[14]。关于动脉瘤对患者再出血情况的研究结果出现差异性,可能与以下情况有关,不同地区由于医疗条件等相关因素的原因,对于动脉瘤的检出率也有一定的差异性^[15]。另外,不同的研究课题对于动脉瘤的诊断标准也存在一定的差异^[16]。故而临床上通过数字减影血管造影(Digital Subtraction Angiography, DSA)对出血是合并来自畸形脑血管团内还是动脉瘤内的判断显得尤为重要^[17]。静脉引流的位置会对畸形血管团的血流动力学产生一定程度的影响^[18]。而文中浅部和双部引流静脉的出血风险明显低于深部,与 Khripun AI 等^[19]人研究结果相一致。静脉回流不畅也会一定程度增加患者再出血的风险。Shotar E 等^[20]人通过将畸形血管团大小分为微型、小型、中型大型以及巨大型进行再出血风险研究,单因素结果提示微型和小型畸形血管团是发生再出血的危险因素,但多因素 Logistic 回归分析不具有统计学意义。而文中通过将畸形血管团分为大小分为 >4 cm、1-4 cm 和 <1 cm 三个级别进行研究,提示大型畸形血管团患者发生再出血的风险明显低于小型血管团患者,与 Champeaux C 等^[21]人研究结果一致。这可能是由于小型畸形血管团可以产生更高更大的血流动力学阻力^[22]。

对于文中结果,研究认为位于小脑、脑干以及丘脑等大脑

深部的急性血管团相对更容易出血,但是其不一定向深部发生引流^[23,24]。深部的急性血管团,一般情况下也位于供血动脉的深部,其供血动脉的长短、直径均会对其再出血产生一定程度的影响,故供血位置对于再出血的影响有待更深层次的研究。引流静脉数目的增加是再出血的危险因素,但是单根引流静脉承担着相对较小的压力,出血的风险也相对较低^[25]。畸形血管团的侧枝供血血管呈现迂曲变形或者袢状,与畸形血管团发生分离,其内部低血压会造成瘤样变的发生^[26,27]。而文中瘤样变并不是再出血的危险因素,这可能是由于其会引起患者血管弹性降低,进而提高再出血的风险^[28]。ROC 曲线的价值由曲线下面积(AUC)大小反映,诊断价值中等为 AUC 值在 0.7-0.9 之间,诊断价值高为 AUC 值不低于 0.9^[29]。文中对于合并动脉瘤、引流静脉方向以及畸形动脉血管团大小 ROC 曲线分析结果提示,预测价值中等的为合并动脉瘤和引流静脉方向,而畸形血管团大小的预测价值相对较低,表明合并动脉瘤和双向引流静脉患者出现再出血的风险相对较大^[30]。

综上所述,合并动脉瘤、引流静脉方向以及畸形动脉血管团大小是脑血管畸形破裂出血的重要危险因素,且对脑血管畸形破裂出血具有一定的预测价值,可为脑血管畸形破裂出血的预防诊治提供参考。

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