

容积旋转调强在局部晚期鼻咽癌放疗中的剂量学特点

许卓华, 黄海欣, 杨慧, 吴思蓓, 江舟, 陆颖
广西医科大学第四附属医院肿瘤二病区, 广西 柳州 545007

【摘要】目的:研究容积旋转调强(VMAT)放射治疗技术在局部晚期鼻咽癌放疗中的剂量学特点。**方法:**选取70例局部晚期鼻咽癌患者,分别对入组患者进行等效均匀剂量优化+双弧VMAT计划设计(EUD组)和剂量-体积优化+双弧VMAT计划设计(DV组),比较两种计划的靶区和部分危及器官(OAR)剂量参数和截面剂量分布情况。**结果:**EUD组均匀性指数和适形度指数均显著低于DV组,靶区和OAR剂量参数显著低于DV组($P<0.05$),尤其是EUD组脑干区域最高剂量在52 Gy以下,显著降低了治疗中损伤脑干的风险;EUD组靶区剂量分布更加均匀,能够减少靶区外高剂量分布和颈部高剂量体积。**结论:**将VMAT技术应用于局部晚期鼻咽癌放疗中时,采取等效均匀剂量优化方法,能够提升靶区均匀性与适形度,有助于改善肿瘤局部控制率,并且能够降低OAR接受剂量,保护作用更加显著。

【关键词】容积旋转调强;放射治疗;局部晚期鼻咽癌;等效均匀剂量优化;剂量学

【中图分类号】R739.6;R811.1

【文献标志码】A

【文章编号】1005-202X(2020)07-0863-04

Dosimetric characteristics of volumetric modulated arc therapy for locally advanced nasopharyngeal carcinoma

XU Zhuohua, HUANG Haixin, YANG Hui, WU Sabei, JIANG Zhou, LU Ying

The Second Cancer Ward, the Fourth Affiliated Hospital of Guangxi Medical University, Liuzhou 545007, China

Abstract: Objective To study the dosimetric characteristics of volumetric modulated arc therapy (VMAT) technique in radiotherapy for locally advanced nasopharyngeal carcinoma (NPC). **Methods** Seventy patients with locally advanced NPC were enrolled in the study. Both equivalent uniform dose optimization + double-arc VMAT plan (EUD group) and dose-volume optimization + double-arc VMAT plan (DV group) were designed for each patient. The dose parameters and cross section dose distributions of target areas and some organs-at-risk (OAR) were compared between two plans. **Results** The homogeneity index and conformity index of EUD group were significantly lower than those of DV group, and the dose parameters of target areas and OAR were significantly lower than those of DV group ($P<0.05$), especially the highest dose of brainstem in EUD group was lower than 52 Gy, which significantly reduced the risk of brainstem injury during treatment. Moreover, the dose distribution of target areas in EDU group was more uniform, which reduced the high dose distribution outside the target areas and decreased the high-dose volume in the neck. **Conclusion** When VMAT technique is applied in the radiotherapy for locally advanced NPC, using equivalent uniform dose optimization can not only improve the homogeneity and conformity of target areas, which is helpful for the improvement of the local control rate of the tumor, but also reduce the dose of OAR, with more significant OAR sparing.

Keywords: volumetric modulated arc therapy; radiotherapy; locally advanced nasopharyngeal carcinoma; equivalent uniform dose; dosimetry

前言

【收稿日期】2019-12-14

【基金项目】广西壮族自治区卫生和计划生育委员会科研项目
(Z20170895); 柳州市科学研究与技术开发计划项目
(2015J030512)

【作者简介】许卓华, 硕士, 主治医师, 研究方向: 鼻咽癌治疗, E-mail:
zx9622good@163.com

【通信作者】陆颖, E-mail: 2404035915@qq.com

神经内分泌细胞属于体内分泌肽类物质的细胞,能够摄取胺前体并脱去其羟基,使其变成活性胺,也被称为APUD细胞,鼻咽癌属于神经内分泌细胞癌的一种^[1-3]。鼻咽癌的临床治疗中,放射治疗属于较为常见的治疗方法,受到位置、结构等因素影响,采取放射治疗的几率较高^[4-6]。在临床治疗中,容积旋转调强放射治疗(VMAT)技术可以在较小MU指数和较少出束时间情况下,形成较高的适形度剂

量分布,已在临床治疗中广泛应用^[7-9]。目前,针对鼻腔神经内分泌癌的治疗尚无统一标准,存在争议,而且针对鼻咽癌进行的研究数量较少。基于此,此次研究选取70例局部晚期鼻咽癌患者,比较不同剂量优化方案下患者的靶区和部分危及器官(OAR)剂量参数和剂量验证结果,明确VMAT技术在局部晚期鼻咽癌放疗中的剂量学特点。

1 资料与方法

1.1 一般资料

选取广西医科大学第四附属医院2017年1月~2019年7月收治的70例局部晚期鼻咽癌患者,其中,男38例,女32例;年龄29~59岁,平均年龄(40.04±4.71)岁。其中II期患者40例,III期患者30例。入组患者均经病理检查证实为鼻咽癌,并且为首次接受放射治疗。入组患者均对试验研究知情并同意。

1.2 方法

放疗采用VAMT技术进行放射治疗,于广西医科大学第四附属医院Trilpgy直线加速器上采用Raystation4.7.5三维治疗计划系统进行设计。勾画肿瘤靶区(GTV),包含鼻咽部肿瘤、口咽淋巴结和颈部肿大淋巴结,肿瘤靶区从前后、左右和头脚方向外扩3 mm作为治疗靶区(PTV)。VMAT的临床处方剂量GTV是70 Gy,至少95%计划PTV能够接受95%的处方剂量照射,OAR包含脑干、脊髓、腮腺及视神经和晶体。采用双弧放疗,逆时针从179°到181°,再顺时针从181°至179°;最大子野数是70,最小子野面积是8 cm²。每个患者设计两个计划,即等效均匀剂量优化+双弧VMAT计划设计(EUD组)和剂量-体积优化+双弧VMAT计划设计(DV组)。比较两种计划的靶区和部分OAR剂量参数和截面剂量分布情况。

1.3 统计学处理

数据采用SPSS19.0统计软件进行处理,计量资料用均数±标准差表示,两组资料用t校验,P<0.05表示差异有统计学意义。

2 结果

2.1 两组靶区和OAR剂量参数比较

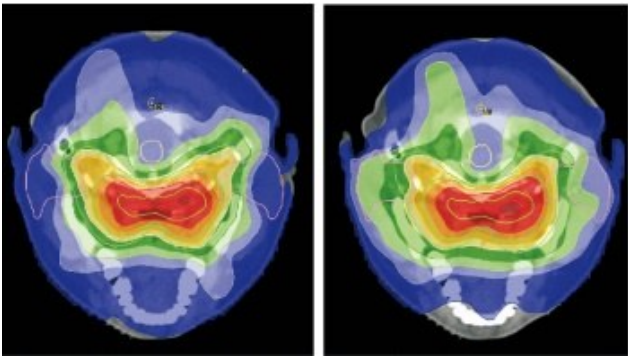
EUD组均匀性指数(HI)和适形度指数(CI)均显著低于DV组,靶区和OAR剂量参数显著低于DV组,均有统计学差异(P<0.05,表1)。

2.2 两组截面剂量分布情况比较

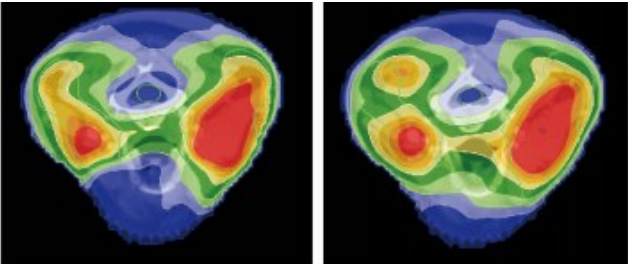
EUD组靶区剂量分布更加均匀,靶区外部高剂量分布和颈部高剂量体积明显减少,如图1和图2所示。

表1 两组靶区和OAR剂量参数比较($\bar{x} \pm s$)
Tab.1 Comparison of dose parameters of target areas and organs-at-risk between two groups (Mean±SD)

指标	EUD组	DV组	t值	P值
CI	1.05±0.03	1.14±0.07	14.026	0.023
HI	0.85±0.03	0.98±0.04	12.958	0.025
脑干D _{max} /Gy	48.21±2.35	51.85±4.01	16.668	0.019
脊髓D _{max} /Gy	41.22±2.98	42.15±3.18	14.425	0.022
腮腺D _{max}	58.59±4.62	60.43±5.26	15.648	0.020
腮腺D _{mean}	28.34±2.11	31.10±3.14	16.854	0.019
视神经D _{mean} /Gy	23.85±1.69	27.98±2.04	18.264	0.017
晶体D _{mean} /Gy	3.64±0.45	5.50±0.52	18.584	0.017



a:EUD组 b:DV组
图1 两组鼻咽部截面剂量分布对比图
Fig.1 Comparison of the cross section dose distribution of the nasopharynx in two groups



a:EUD组 b:DV组
图2 两组颈部截面剂量分布对比图
Fig.2 Comparison of the cross section dose distribution of the neck in two groups

3 讨论

鼻咽癌是一种发生在鼻咽腔顶部和侧壁的恶性肿瘤,在我国属于临床发病率较高的恶性肿瘤之一,其发病率位于耳鼻咽喉恶性肿瘤的首位^[10-12]。原发性鼻咽癌的临床症状主要有涕血、鼻出血以及耳部和鼻部症状,黏膜下型患者发生涕血的几率较低。

部分鼻咽癌患者会出现单侧持续性头痛症状,当鼻咽癌发生到晚期阶段时,部分患者出现眼部相关症状^[13-15]。鼻咽癌大部分对放射治疗具有高度敏感性,因此放射治疗是鼻咽癌的首选治疗方式^[16]。

EUD指的是生物等效剂量^[17-18]。此次研究中,对比分析EUD优化用于VMAT技术和传统物理优化的VMAT技术对鼻咽癌放疗计划的影响,明确两种剂量优化方式的优势,分析VMAT技术应用于鼻咽癌放疗治疗的剂量特点。研究结果表明:EUD组HI和CI均显著低于DV组,靶区和OAR剂量参数显著低于DV组($P<0.05$);EDU组的靶区剂量分布更加均匀,靶区外部高剂量分布和颈部高剂量体积明显减少^[19]。EUD优化VMAT计划能够使高靶区剂量分布得到进一步提升,并且可以降低OAR受照剂量,对提升肿瘤控制率与降低并发症风险具有积极意义,还能够促进患者生活质量的改善^[20]。靶区受照剂量满足临床要求的基础上,EUD优化能够使高剂量分布的适形度和均匀性得到显著提升,同时降低OAR受照剂量,脑干最大剂量能够保证在50 Gy以下,腮腺平均剂量能够保证在30 Gy之内。

综上所述,将VMAT技术应用于局部晚期鼻咽癌放疗中时,采取EUD优化方法,能够使靶区均匀性与适形度得到提升,有助于改善肿瘤局部控制率,并且能够降低OAR受照剂量,保护作用更加显著。

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