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## 数字化远程介入手术示教的实践与思考

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**摘要 目的:**探讨介入手术远程演示教学系统的应用及效果。**方法:**采取多机组、多屏幕实况转播,将导管室的高清血管造影图像、术野图像、全景图像传输到会场。**结果:**学员对介入手术远程转播满意度为100%,其中最满意的是转播交互环节。本次共进行10台手术远程转播,无一例转播相关并发症发生,患者对治疗评价均及保护隐私情况非常满意。基本实现了导管室与会场的双向音视频互动,学员同术者在手术过程中的直接交流起到了较好的教学效果。**结论:**介入手术演示已经成为继续医学教育必不可少的手段,数字化介入手术转播是将来介入手术转播的发展方向。

**关键词:**数字化教学;远程转播;介入放射

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## Practices and Considerations of Digital Remote Interventional Live Case Presentation

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**ABSTRACT Objective:** To discuss the application of the long-range demonstration of interventional procedures on the clinical teaching. **Methods:** The multi-video cameras and multi-monitors were used to demonstrate interventional procedures in national continuous education work-shop. **Results:** The satisfaction of students on the remote broadcast intervention operation was 100%, and the most satisfactory was the interaction link. There was no related complications in the ten remote interventional surgeries with the satisfaction of patients for treatment and privacy. Follow-up showed that teaching efficacy was achieved by this way. **Conclusions:** It is indicated that the remote interventional live case presentation has become one of the indispensable methods for the development of digital radiology.

**Key words:** Digital teaching; Remote Presentation; Interventional radiology

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### 前言

介入放射学是二十世纪七十年代后期迅速发展起来的一门新兴的诊疗学科,它是在医学影像设备的引导下,以影像诊断学和临床诊断学为基础,结合临床治疗学原理,利用导管、导丝等器材对各种疾病进行诊断及治疗的一门微创学科,现已成为与内科、外科治疗学并驾齐驱的第三大治疗学科<sup>[1-3]</sup>。随着介入放射学的发展,介入放射学专业学术会议也日益增多,介入手术演示已经成为继续医学教育必不可少的手段,是传统医学教育方法在通信和转播技术空前发展时期的扩展<sup>[4,5]</sup>。与外科手术不同的是,介入手术不仅要求医师的手部操作技术,术中血管造影的影像质量也非常重要<sup>[6]</sup>。解放军总医院介入放射科在3届国家继续教育学习班上采用了多机组、多屏幕实况转播,实现了导管室与会场的双向音视频互动,收到良好的教学效果,现总结如下。

### 1 资料与方法

#### 1.1 一般资料

参与转播工作的人员类别包括医生、技师、护士、转播工程师等,其中医生负责同外籍专家沟通和配合手术;技师负责操作数字减影血管造影机(Digital Subtraction Angiography, DSA)、高压注射器等设备;护士负责手术准备和术中配合;转播工程师负责布置转播仪器设备等。

#### 1.2 方法

转播工作由主管医师和护士长统一领导。会议期间,各项工作实行专人负责,急救用品、导管材料、护理记录、接送病人、材料收费、设备维护、消毒隔离、术前访视等均由专人负责。通过摄像机采集导管室全景图像和介入手术医师手部操作图像,将血管造影图像通过视频接口和相关软件转换成电视信号,通过视频线进行转播。转播期间特邀数字减影血管造影机工程师在会议期间进行现场使用维护,转播设备均由转播工程师负责安装、调试。在专人负责的基础上,合理分工,如:主管医师负责与患者谈话签字,除常规交代手术过程、风险等情况外,还应详细解释转播过程可能出现的问题,保护患者的隐私。每间 DSA

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手术间有 2 名护士和 1 名技师配合,其中 1 名护士负责手术间内病人护理和配合医生手术,另 1 名护士负责在手术间外进行护理记录等,技师负责操作 DSA 机器和高压注射器等设备。另设置专用场所由一名护士全面负责手术前无菌包的开启及常规材料准备,随时提供手术所需,以缩短手术接台时间。介入放射科病房全面负责处理术后医嘱及观察病情<sup>[7-10]</sup>。

### 1.3 问卷调查

采用问卷调查的形式对远程教学的效果进行调查,主要涉及:学员对介入手术远程转播的满意度,患者对数字化治疗的满意度。

## 2 结果

三届国家继续教育学习班共收回有效调查问卷 436 份,调查问卷显示:学员对介入手术远程转播满意度为 100%,其中学员尤其对转播的交互环节感到满意,学员同术者在手术过程中的直接交流起到了较好的教学效果。本次共进行 10 台手术远程转播,无一例转播相关并发症发生,患者对治疗评价均及保护隐私情况极为满意。

## 3 讨论

以往的会议均采用有线电视技术,利用音频/视频信号线进行语音/图像的传输,不需要增加任何中间设备,图像失真小,但有线电视技术难以存储数据,不利于教学资料的保存,而且更远距离(超过 50 米)的信号传输通过有线电视技术难以实现<sup>[1]</sup>。而数字化介入手术转播是通过术野摄像机、全景摄像头进行手术图像采集、同时采集术中介入图像,采用无线麦克采集音频信号,通过中央控制室将导管室的音视频信号压缩编码后,利用网络传输至终端,终端采用解码器将数字信息还原,播放实时音视频信号,实现远程示教观摩<sup>[12,13]</sup>。该转播系统还可以通过工作人员操作计算机,控制导管室内全景摄像头来调整镜头变焦、水平和垂直方位,对介入术中图像进行后处理,使远程示教室内观摩、会诊的医护人员可以清晰的观看介入手术全过程<sup>[14]</sup>。

介入转播系统包括两个方面:介入手术所需仪器设备和转播仪器设备。介入手术对仪器设备和各种耗材的依赖性极高,转播前提是维护和保养介入手术相关仪器设备,包括:数字减影血管造影机、射频消融机、心导管工作站及对讲系统等,以确保会议期间仪器设备运行正常、介入手术顺利进行。转播仪器设备包括:视频设备(摄像机),音频设备(无线麦克风和耳机),监控系统,功放系统,音频/视频信号线等<sup>[17,18]</sup>。介入手术是通过血管造影图像的视频信号反映出来的。因此,确保血管造影图像视频信号的高清晰度,转播优质高效的信号是重点。在我们的转播演示教学中,我们在导管室转播系统中安排了三路视频信号转播,满足了介入手术转播的要求,将导管室现场图像、手术视野图像和数字减影图像传送至会场,会场安排专业人员进行手术的解说,并同时与主刀医生进行交互,让与会人员身临其境的参与手术过程,便于与会人员对手术的过程进行研讨,很好的解决了学员难以身临其境参观介入手术操作的问题,取得了良好的教学效果。我们同时争取了后勤保障部门的全面配合,确定相关保障部门及人员名单,保证及时排除突

发情况。提前做好水电检修工作,检查消防安全设施,确保会议期间仪器设备安全。在手术演示期间,存在着高危、复杂手术多,医、护、技对外籍专家手术习惯不熟悉、与外籍专家沟通欠顺畅等因素,需要各方密切沟通,通力协作。不仅要加强医护之间、护护之间、护患之间沟通,而且必须根据会务组的相关安排及现场直播的要求准备转播工作<sup>[19,20]</sup>。我们对相关人员进行了提前演练,积极组织术前讨论,更全面地了解病人病情,有计划、有组织地进行模拟现场的手术演练,以保证成功的介入手术演示。

目前,我科已完成了数字化导管室的建设,安装了相关图像采集装置和中央控制设备,我院院内局域网网络传输速度已达到千兆以上,具有良好的网络通讯环境,很大程度上为实现介入手术转播数字化、远程化迈出了一大步,为下一步举办国际会议进行"上星"的介入手术转播提供了条件,也标志着我院介入手术转播进入一个新的阶段。综上所述,远程医疗作为一门跨学科的高新技术,已成为医疗服务和救护保障的新模式。

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