

# 经导管动脉栓塞治疗地震伤挤压综合征 巨大创面大出血

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**【摘要】** 目的 评价经导管动脉栓塞治疗地震伤挤压综合征伴巨大创面大出血的安全性和有效性。方法 2008年5月12日—5月26日,收治“5·12”汶川大地震挤压综合征伴巨大创面大出血伤员11例。男6例,女5例;年龄16~36岁,平均21岁。创面共19处,均发生感染。出血部位:髋部创面7例,大腿残端创面3例,肩部创面1例。伴失血性休克6例。11例伤员均行动脉造影明确出血血管,根据造影结果行导管动脉栓塞治疗。动脉栓塞后48h行增强螺旋CT扫描、CT三维血管成像检查有无造影剂外漏及栓塞部位远端血管有无塌陷。结果 11例伤员动脉栓塞后行造影检查无造影剂外漏,栓塞平面以远动脉分支不显影,出血动脉栓塞血压明显回升,栓塞成功。栓塞后48h创面无活动性出血。6例发生失血性休克的伤员行动脉栓塞后,创面出血明显减少;予支持治疗后血压逐渐回升,生命体征逐渐恢复正常,病情稳定;栓塞后24h输液总量6 750~19 600 mL,平均8 740 mL,输血和血浆总量1 800~6 400 mL,平均3 500 mL。增强螺旋CT扫描示6例远端血管不显影,无造影剂外漏,CT三维血管成像示远端血管塌陷;5例远端血管显影,无造影剂外漏,CT三维血管成像示远端血管仍充盈,血管腔明显变细。无臀部和髋部肌肉坏死、膀胱坏死、排尿困难、大便失禁、阳痿等严重并发症发生。结论 动脉栓塞是治疗挤压综合征巨大创面大出血的安全、快速、有效且微创的方法。

**【关键词】** 汶川大地震 挤压综合征 大出血 动脉栓塞 软组织缺损  
中图分类号: R181.2 R687.4 文献标志码: A

**EFFECT OF TRANSCATHETER ANGIOGRAPHIC EMBOLIZATION ON MASSIVE HAEMORRHAGE FROM LARGE WOUND DUE TO CRUSH SYNDROME AFTER WENCHUAN EARTHQUAKE/WANG Guanglin, PEI Fuxing, HUANG Fuguo, TU Chongqi, YANG Tianfu, SONG Yueying, ZHANG Hui. Department of Orthopaedics, West China Hospital, Sichuan University, Chengdu Sichuan, 610041, P.R.China. Corresponding author: PEI Fuxing, E-mail: peifuxing@vip.163.com**

**【Abstract】 Objective** To evaluate the safety and efficacy of transcatheter angiographic embolization (AE) in the control of massive haemorrhage from large wound due to crush syndrome after Wenchuan earthquake. **Methods** From May 12 to May 26, 2008, 11 injured persons in Wenchuan earthquake with massive haemorrhage from large wound due to crush syndrome were treated, including 6 males and 5 females aged 16-36 years old (average 21 years old). All 19 wounds were infected. The hemorrhage was from the hip in 7 cases, the thigh stump in 3 cases, and the shoulder in 1 case. Six patients had hemorrhagic shock. All patients underwent arteriography to locate the bleeding artery, and transcatheter AE was performed according to the result of arteriography. Contrast-enhanced spiral CT scan and three-dimensional angiography were performed 48 hours after AE to evaluate leakage of contrast media and collapse of distal artery of embolism site. **Results** Angiography for 11 injured persons after AE showed no occurrence of contrast media leakage, faint shadow to the distal branch artery of embolic level, and significant increase of blood pressure of the bleeding artery, indicating the embolization was successful. No active hemorrhage was evident in the wounds 48 hours after AE. For the 6 patients with hemorrhagic shock, obvious decrease of hemorrhage was observed after AE, gradual recovery of blood pressure and vital signs, and stability of their condition were evident after supportive therapy. During the first 24 hours after AE, total volume of infusion was 6 750-19 600 mL (average 8 740 mL), and total volume of blood and plasma transfusion was 1 800-6 400 mL (average 3 500 mL). In 6 cases, contrast-enhanced spiral CT scan demonstrated faint shadow of the distal artery without contrast media leakage, and three-dimensional CT angiography showed collapse of the distal artery; in the rest 5 cases, contrast-enhanced spiral CT scan demonstrated shadow of the distal artery without contrast media leakage, and three-dimensional CT angiography displayed the full-filling of distal artery with obviously decreased vascular cavity. No severe complications such as muscle necrosis in the buttock and hip, bladder necrosis, dysuria, fecal incontinence, and impotence occurred. **Conclusion** The transcatheter AE is a safe, fast, effective and mini-invasive method of controlling massive haemorrhage from large wound caused by crush syndrome after Wenchuan earthquake.

**【Key words】** Wenchuan earthquake    Crush syndrome    Massive hemorrhage    Angiographic embolization    Soft tissue defect

挤压综合征是指身体肌肉丰富的部位受挤压后出现以肌红蛋白尿、高血钾、酸中毒和氮质血症等为特点,急性肾功能衰竭为主要表现的临床综合征<sup>[1-3]</sup>。肢体发生筋膜室综合征时需行筋膜室切开减压,且组织坏死、严重感染、长时间受压致肢体发生坏死需开放性截肢,均可能形成全身多处巨大创面;而急性肾功能衰竭需行持续肾脏替代治疗(continuous renal replacement therapy, CRRT),导致创面广泛渗血<sup>[4-6]</sup>。当出现动脉性大出血时,组织坏死界限不清楚,若发生严重炎症反应,创面局部止血非常困难。采用经导管动脉造影,查明出血部位后进行动脉栓塞,可安全、有效、快速地控制出血。我科于2008年5月12日—5月26日采用经导管动脉栓塞治疗“5·12”汶川大地震挤压综合征伴巨大创面、动脉性大出血伤员11例。报告如下。

## 1 临床资料

### 1.1 一般资料

本组男6例,女5例;年龄16~36岁,平均21岁。致伤原因:建筑物倒塌后掩埋受压10例,山体塌方汽车受压变形后挤压伤1例。受挤压时间8~73 h,平均26 h。创面共19处,其中8处为髋部巨大创面,5处为髋关节开放性离断后形成,2处为双侧髋部、腰背部组织广泛坏死、感染,坏死组织清除后形成的双侧髋部巨大创面,1处为大腿及髋部筋膜室综合征切开减压形成的巨大创面;大腿创面6处、小腿创面4处、肩部创面1处,均为开放性截肢后形成。19处创面均发生感染,其中5处为鲍曼不动杆菌,5处为铜绿假单胞杆菌,4处为肺炎克雷伯杆菌,2处为大肠埃希杆菌,2处为阴沟肠杆菌,1处为粪肠球菌;1例出现气性坏疽伤员曾培养出粗大牙孢杆菌。出血部位:髋部创面7例,大腿残端创面3例,肩部创面1例。

### 1.2 治疗方法

11例均发生急性肾功能衰竭,10例行CRRT治疗,1例行间隙血液透析治疗。6例发生失血性休克,均为髋部创面大出血所致。抢救休克时立即压迫创面出血部位,快速输液、输血和血浆等抗休克治疗。待血压回升后,检查发现创面有活动性出血,予油纱填塞、皮肤宽边距缝合、局部加压包扎结合外层敷料经双侧髋部加压包扎后立即在局麻下行动脉造影,出血动脉栓塞。

所有伤员均采用Sedinger技术经皮股动脉穿刺插管,导管至髂总动脉分叉处行动脉造影,明确出血血管。11例伤员均可见明显动脉期造影剂外漏,呈条状

或片状,不能迅速排空,随着时间推移范围扩大,边缘模糊不清,无引流静脉。7例髋部创面大出血者出血动脉主要是髂内动脉分支:臀上动脉4例,臀下动脉5例,闭孔动脉2例,腰动脉2例,旋股外动脉2例。4例大腿残端创面出血者出血动脉包括股深动脉穿支和肌支2例,旋股内动脉和残端肌肉内动脉2例。1例肩部创面出血者采用锁骨下动脉穿刺造影,出血动脉为肱深动脉。

根据造影检查结果,在透视监控下经导管放置14号金属弹簧圈,血流速度缓慢后,依次放置从12号到5号金属弹簧圈,行血管内栓塞。弹簧圈的用量根据透视下被栓塞血管的血流速度而定。7例髋部大出血者,5例髋关节开放性离断和1例双侧髋部创面,出血侧已行大腿上段开放性截肢,选择栓塞出血侧髂总动脉和对侧髂内动脉;1例选择双侧髂内动脉栓塞。4例大腿残端创面出血者,2例选择髂外动脉栓塞,2例选择股动脉栓塞。1例肩部创面出血者行腋动脉栓塞。栓塞成功的指征为无造影剂外漏,且栓塞平面以远动脉分支不显影,出血动脉被栓塞后血压回升。

### 1.3 术后处理及影像学评价

术后密切观察伤员生命体征,穿刺部位沙袋压迫24 h,予输液和输血、血浆、白蛋白等抗休克、抗感染及支持治疗,继续行CRRT治疗。待休克纠正、生命体征稳定、创面渗血减少、动脉栓塞48 h、检查创面无动脉性出血后,行增强螺旋CT扫描、动脉血管三维成像检查有无造影剂外漏及栓塞部位远端血管有无塌陷。

## 2 结果

11例伤员动脉栓塞后立即行造影检查示无造影剂外漏,且栓塞平面以远动脉分支不显影,血压明显回升,栓塞成功。栓塞后48 h检查创面无活动性出血。6例发生失血性休克的伤员行动脉栓塞后,创面出血减少;继续予输液、输血和输血浆等支持治疗后血压逐渐回升,生命体征恢复正常,病情稳定;栓塞24 h输液总量6 750~19 600 mL,平均8 740 mL,输血和输血浆总量1 800~6 400 mL,平均3 500 mL。增强螺旋CT扫描示6例远端血管不显影,无造影剂外漏,CT三维血管成像显示远端血管塌陷;5例远端血管显影,无造影剂外漏,CT三维血管成像显示远端血管仍充盈,但血管腔明显变细。本组均无髋部和髋部肌肉坏死、膀胱坏死、排尿困难、大便失禁、阳痿等严重并发症发生。

### 3 典型病例

伤员 男, 35 岁。地震时房屋倒塌被预制板挤压致右下肢、臀部及会阴区肿胀出血 24 h, 于当地医院治疗, 因病情加重伤后 5 d 转入我院。检查: 右腹股沟及会阴区创面坏死组织较多, 大量渗出伴恶臭, 右下肢大腿中份以远发黑坏死; Hb 106 g/L, PLT  $79 \times 10^9/L$ , 肌酐  $464.6 \mu\text{mol/L}$ , 尿素氮  $49.1 \text{ mmol/L}$ , 天门冬氨酸氨基转移酶  $1996 \text{ U/L}$ , 丙氨酸转氨酶  $1819 \text{ U/L}$ , 血钾  $5.8 \text{ mmol/L}$ 。诊断为挤压综合征、右下肢坏疽、急性肾功能衰竭、急性肝功能损害及高钾血症。行抗感染、全身支持及 CRRT 治疗。伤后第 10 天, 伤员反复出现高热, 体温  $38.0 \sim 39.5^\circ\text{C}$ , 血培养发现屎肠球菌阳性, 诊断为败血症, 行右髂开放性离断术。创面每日大量渗血和渗液, Hb 和 PLT 进行性减少为  $45 \text{ g/L}$  和  $3 \times 10^9/L$ 。伤后第 26 天, 伤员创面突发活动性大出血, 生命体征不稳定, HR 153 次 / 分、BP 73/55 mm Hg ( $1 \text{ mm Hg}=0.133 \text{ kPa}$ )、R 41 次 / 分, 出现休克表现。给予快速输液、输血和血浆等支持治疗后, 检查创面多处出血, 予纳米银纱填塞、局部缝合打包加压包扎、结合外层敷料经对侧髂部加压包扎。立即在局麻下经对侧股动脉穿刺, 行动脉造影, 发现右臀上动脉和臀下动脉多个分支出血, 行右髂总动脉栓塞和左侧髂内动脉栓塞。栓塞后立即行造影检查无造影剂外漏, 栓塞平面以远动脉分支不显影, 血压回升, 栓塞成功。术

后创面出血、渗出减少, 24 h 输液总量为 7 500 mL, RBC 悬液 2 200 mL, 血浆 1 600 mL, PLT 600 mL, 尿量 170 mL, 生命体征稳定。栓塞后 48 h 行增强螺旋 CT 扫描发现远端血管不显影, 无造影剂外漏, CT 三维血管成像显示远端血管虽充盈, 但血管腔明显变细。经纠正贫血及低蛋白血症, 补充 PLT、新鲜血浆等支持治疗后, 于伤后 28 d 再次扩创清除臀部坏死组织及右侧睾丸及精索后, 渗血和渗液明显减少, Hb 和 PLT 逐渐恢复正常, 病情好转。见图 1。

### 4 讨论

#### 4.1 经导管动脉栓塞的作用

地震伤挤压综合征伤员由于急性肾功能衰竭需行 CRRT 治疗, 由于 CRRT 需应用抗凝剂, 同时伤员凝血机制异常及低 PLT 等, 发生创面大出血时, 出血很难控制, 需要探查出血部位并结扎出血动脉。但患者创面内组织坏死边界不清, 肿胀及感染严重, 炎性肉芽组织脆性大, 难以探查并结扎出血动脉。本组 11 例均发生急性肾功能衰竭, 10 例行 CRRT 治疗, 1 例行间隙血液透析治疗。经导管动脉造影可发现出血部位并行血管栓塞治疗, 避免了开放手术的缺点 [7-8]。Velmahos 等 [9] 报道对骨盆骨折引起进行性出血的患者, 采用双侧髂内动脉栓塞控制出血有效率达 95.1%, 安全性 94.6%。本组术后行造影检查均显示栓塞成功, 栓塞后 48 h 创面无活动性出血, 渗血和渗出明显减少, 说明动脉造影

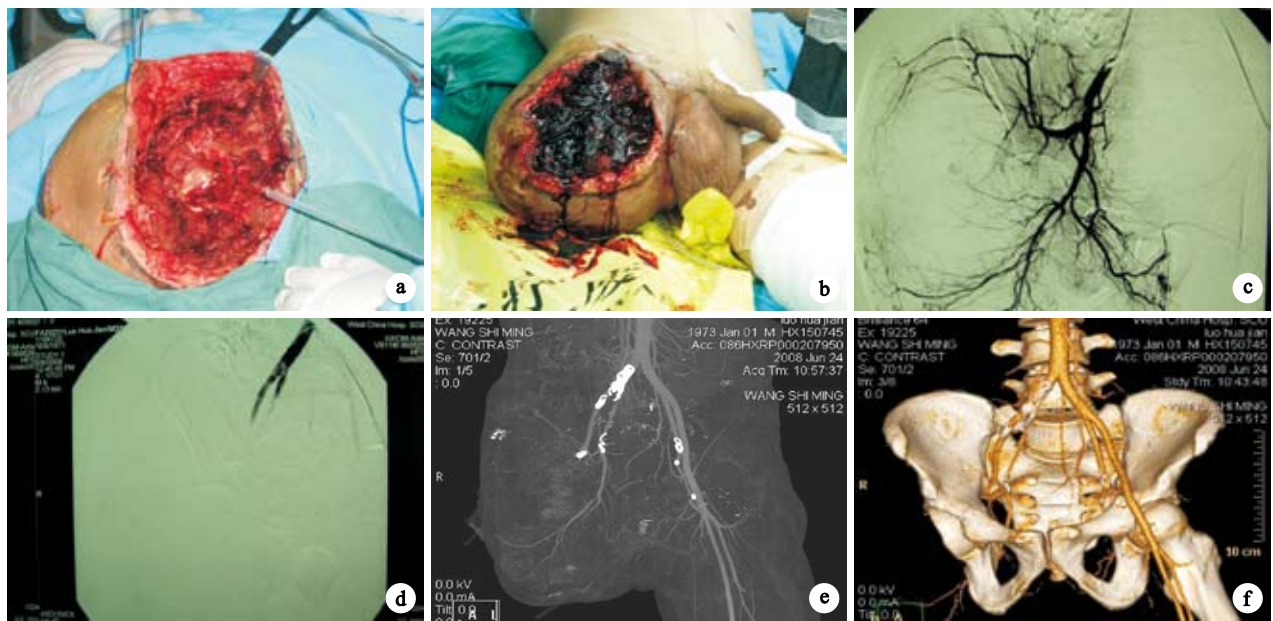


图 1 典型病例 伤员, 男, 35 岁, 地震挤压综合征, 右下肢坏疽 (a) 术前右髋部巨大创面 (b) 术前右髋部巨大创面出血 (c) 术前动脉造影发现出血动脉 (d) 栓塞后即刻血管造影 (e) 栓塞后 48 h CT 血管成像 (f) 栓塞后 48 h CT 三维血管成像

Fig.1 A 35-year-old injured male with crush syndrome after Wenchuan earthquake and gangrene of the right lower extremity (a) Large wound of the right hip before operation (b) Hemorrhage from large wound of the right hip before operation (c) Bleeding artery detected by preoperative angiography (d) Angiography immediately after embolization (e) CT angiography 48 hours after embolization (f) Three-dimensional CT angiography 48 hours after embolization

血管栓塞控制地震伤挤压综合征伴巨大创面大出血具有创伤小、安全、有效的优点。

#### 4.2 动脉栓塞部位和材料选择

动脉栓塞主要有选择性主干动脉栓塞和超选择性出血分支动脉栓塞两种方法<sup>[10]</sup>。骨盆骨折大出血行动脉栓塞时,由于有丰富的侧支循环,多数学者主张采用双侧髂内动脉主干栓塞,而单纯的超选择性出血分支动脉栓塞,其循环动态发生变化可导致再出血发生,且操作困难,耗时较长,不利于急救控制出血<sup>[14-16]</sup>。本组11例均采用选择性主干动脉栓塞,术后创面出血和渗血明显减少,未再发生活动性大出血;未出现臀部和骶部肌肉坏死、膀胱坏死、排尿困难、大便失禁、阳痿等严重并发症;表明主干动脉栓塞是地震伤挤压综合征伴创面大出血时安全、有效的止血方法。

栓塞材料目前主要有明胶海绵和金属弹簧圈。金属弹簧圈具有栓塞定位准确、栓塞效果永久、便于摄片及长期随访观察,并能通过较细的导管完成大口径血管栓塞的优点<sup>[17]</sup>。本组11例地震伤挤压综合征伤员创面巨大,出血严重,治疗周期较长,为避免明胶海绵吸收后再出血,均选用金属弹簧圈栓塞主干动脉。术后即刻CT血管成像检查发现金属弹簧圈均位于血管腔内,远端血管不显影,无造影剂外漏;CT三维血管成像显示远端血管塌陷,进一步表明金属弹簧圈是地震挤压综合征伴巨大创面大出血时良好的栓塞材料<sup>[18-19]</sup>。

#### 4.3 积极抗休克治疗

地震伤挤压综合征伤员由于伤情严重,创面渗出多,合并严重贫血、低蛋白血症、败血症、多器官功能衰竭等,发生大出血后很容易引起失血性休克<sup>[10-11]</sup>。本组6例发生失血性休克。抢救休克时应注意以下几点:①立即压迫止血:采用双手掌压迫出血部位,暂时止血后给予快速输液、输血和血浆支持治疗,待血压回升、心率减慢后再打开创面敷料,检查出血情况,不能在生命体征不稳定时检查创面,否则可能增加出血并加重休克。②主干动脉栓塞,彻底止血。不能仅超选择性栓塞出血分支动脉,而要栓塞主干动脉,彻底止血,避免继发出血,加重休克。③足量补充胶体成分:在监测中心静脉压情况下,足量补充血、血浆、PLT、白蛋白等胶体成分,不能过分依靠血管活性物质来维持BP<sup>[12-13]</sup>。6例发生失血性休克伤员术后24h平均输血量达8740mL,输血和血浆达3500mL,生命体征才恢复正常,病情逐渐稳定。

#### 5 参考文献

1 Sever MS, Vanholder R, Lameire N. Management of crush-related injuries after disasters. *N Engl J Med*, 2006, 354(10): 1052-1063.

2 Gonzalez D. Crush syndrome. *Crit Care Med*, 2005, 33(1 Suppl): S34-41.

3 Duman H, Kulahci Y, Sengezer M. Fasciotomy in crush injury resulting from prolonged pressure in an earthquake in Turkey. *Emerg Med J*, 2003, 20(3): 251-252.

4 Better OS, Rubinstein I, Reis D. Muscle crush compartment syndrome: fulminant local edema with threatening systemic effects. *Kidney Int*, 2003, 63(10): 1155-1157.

5 Wu MJ, Lian JD, Lee MC. *et al.* Rhabdomyolysis following crush injury in the Taiwan Chi-Chi earthquake. *Acta Nephrologica*, 2005, 19: 62-67.

6 王锦权, 赵劲松, 潘爱军, 等. 连续性血液净化对多器官功能障碍综合征患者评分和凝血功能的影响. *中华急诊医学杂志*, 2003, 12(2): 79-81.

7 Fangio P, Asehnoune K, Edouard A, *et al.* Early embolization and vasopressor administration for management of life-threatening hemorrhage from pelvic fracture. *J Trauma*, 2005, 58(5): 978-984.

8 Cook ER, Keating FJ, Gillespie I. The role of angiography in the management of haemorrhage from major fractures of the pelvis. *J Bone Joint Surg (Br)*, 2002, 84(2): 178-182.

9 Velmahos GC, Toutouzas KG, Vassiliu P, *et al.* A prospective study on the safety and efficacy of angiographic embolization for pelvic and visceral injuries. *J Trauma*, 2002, 53(2): 303-308.

10 Weigert AL, Schafer AL. Uremic bleeding: pathogenesis and therapy. *Am J Med Sci*, 1998, 316(2): 94-104.

11 Matsuoka T, Yoshioka T, Tanaka H, *et al.* Long-term physical outcome of patients who suffered crush syndrome after the 1995 Hanshin-Awaji earthquake: prognostic indicators in retrospect. *J Trauma*, 2002, 52(1): 33-39.

12 Kauvar DS, Lefering R, Wade CE. Impact of hemorrhage on trauma outcome: an overview of epidemiology, clinical presentations, and therapeutic considerations. *J Trauma*, 2006, 60(6 Suppl): S3-11.

13 Ketchum L, Hess JR, Hii ppala S. Indications for early fresh frozen plasma, cryoprecipitate, and platelet transfusion in trauma. *J Trauma*, 2006, 60(6 Suppl): S51-58.

14 Takahira N, Shindo M, Tanaka K, *et al.* Gluteal muscle necrosis following transcatheter angiographic embolization for retroperitoneal hemorrhage associated with pelvic fracture. *Injury*, 2001, 32(1): 27-32.

15 Yasumura K, Ikegami K, Kamohara T, *et al.* High incidence of ischemic necrosis of the gluteal muscle after transcatheter angiographic embolization for severe pelvic fracture. *J Trauma*, 2005, 58(5): 985-990.

16 Holcomb JB, Jenkins D, Rhee P, *et al.* Damage control resuscitation: directly addressing the early coagulopathy of trauma. *J Trauma*, 2007, 62(2): 307-310.

17 Velmahos GC, Chahwan S, Hanks SE, *et al.* Angiographic embolization of bilateral internal iliac arteries to control life threatening hemorrhage after blunt trauma to the pelvis. *Am Surg*, 2000, 66(9): 858-862.

18 Osborn TM, Bell B, Qaisi W, *et al.* Computed tomographic angiography as an aid to clinical decision making in the selective management of penetrating injuries to the neck: a reduction in the need for operative exploration. *J Trauma*, 2008, 64(6): 1466-1471.

19 Inaba K, Munera F, Rivas L, *et al.* Computed tomographic angiography in the initial assessment of penetrating extremity injuries. *J Trauma*, 2007, 62(2): 520-522.

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