

doi: 10.13241/j.cnki.pmb.2018.06.014

• 临床研究 •

PICCO 在老年髋关节手术麻醉及血流动力学优化中的应用

林冬阳 周海军 朱 明[△] 胡 燕 苏 喆

(上海交通大学医学院附属同仁医院(上海市同仁医院)麻醉科 上海 200336)

摘要 目的:探讨脉搏指示持续心输出量(pulse induced contour cardiac output, PICCO)技术在老年髋关节手术麻醉及血流动力学优化中的临床应用。**方法:**将 106 例老年髋关节手术患者随机分成 2 组,每组各 53 例。常规组放置中心静脉导管和动脉导管, PICCO 组放置 PICCO,检测平均动脉压(mean arterial pressure, MAP)、中心静脉压(central venous pressure, CVP)、心率(heart rate, HR)、心指数(cardiac index, CI)、血管外肺水指数(extravascular lung water index, ELWI)、胸腔内血容量指数(intrathoracic blood volume index, ITBI)及肺血管通透性指数(pulmonary vascular permeability index, PVPI)等血流动力学参数。记录 PICCO 组术中各指标的变化,比较分析两组术后前 3 天液体摄入量,术后并发症发生情况。**结果:**与 T0 时点比较, PICCO 组 T1 时点的 MAP、CVP、CI、ITBI 明显降低, HR 明显升高($P<0.05$); T2 时点 MAP、CVP、CI 较 T1 明显升高, HR 明显下降($P<0.05$); PICCO 组 T2 时刻各血流动力学指标均明显优于常规组($P<0.05$)。 PICCO 组术后前 3 天的液体摄入量明显少于常规组($P<0.05$); ELWI 与 PVPI、ITBI、液体摄入量均呈高度正相关($P<0.05$)。且 PICCO 组术后肺部感染及心血管并发症的发生率也较常规组明显降低($P<0.05$)。**结论:** PICCO 监测可准确反映血流动力学状态参数,指导临床麻醉和围术期液体管理,减少术中术后不良并发症,改善患者预后。

关键词:脉搏指示持续心输出量技术;老年;髋关节手术;麻醉;血流动力学

中图分类号: R614; R687.3 **文献标识码:** A **文章编号:** 1673-6273(2018)06-1073-04

Application of PICCO for Anesthesia and Hemodynamic Optimization in Hip Surgery in Senile Patients

LIN Dong-yang, ZHOU Hai-jun, ZHU Ming[△], HU Yan, SU Zhe

(Shanghai Jiaotong University School of Medicine Affiliated Tongren Hospital (Shanghai Tongren Hospital) Anesthesiology, Shanghai, 200336, China)

ABSTRACT Objective: To explore the application of pulse induced contour cardiac output (PICCO) for anesthesia and hemodynamic optimization in hip surgery in senile patients. **Methods:** 106 senile patients received hip surgery were randomly and equally divided into two groups. General group was given central venous catheter and ductus arteriosus for hemodynamic monitoring, and PICCO group was given PICCO to obtain the hemodynamic indicators including mean arterial pressure (MAP), central venous pressure (CVP), heart rate (HR), cardiac index (CI), extravascular lung water index (ELWI), intrathoracic blood volume index (ITBI), pulmonary vascular permeability index (PVPI). **Results:** Compared with T0, There were lower in the numerous of MAP, CVP, CI, ITBI, and higher HR than those of T1, the numerous of MAP, CVP, CI at T2 were higher, HR was lower than those at T1 ($P<0.05$). The indicators of hemodynamic at T2 in PICCO group were significantly higher than those in general group ($P<0.05$). The fluid intake of PICCO group were less than those of general group ($P<0.05$). ELWI has significant positive relationship with PVPI, ITBI, fluid intake ($P<0.05$), the complications incidence of postoperative pulmonary infection and cardiovascular were remarkably lower than those of general group ($P<0.05$). **Conclusions:** PICCO monitoring can accurately reflect the hemodynamic parameters, guide the clinical anesthesia and perioperative fluid management, reduce intraoperative and postoperative complication, improve the prognosis.

Key words: Pulse induced contour cardiac output; Senile patients; Hip surgery; Anesthesia; Hemodynamics

Chinese Library Classification(CLC): R614; R687.3 **Document code:** A

Article ID: 1673-6273(2018)06-1073-04

前言

髋关节手术是老年患者常见的骨科手术之一,此类手术通常创伤较大,术中常会出现剧烈的血流动力学波动。老年人各

项生理功能发生不同程度的退行性变化,尤以心脑血管及中枢神经系统最为明显,对麻醉和手术的耐受性较差,并发症的发生率高^[1]。因此,老年人髋关节手术的风险高,麻醉管理难度大。加强血流动力学监测、优化麻醉策略、提高麻醉质量有助于预

作者简介:林冬阳(1981-),硕士,主治医师,研究方向:临床麻醉与疼痛诊疗, E-mail: dongyang1981@126.com

[△] 通讯作者:朱明(1975-),硕士,副主任医师,研究方向:临床麻醉,危重病人监护及治疗, E-mail: zhuminggulei@163.com

(收稿日期:2017-08-07 接受日期:2017-08-30)

防和减少术中、围手术期的严重不良事件^[2]。

脉搏指示持续心输出量(PICCO)是一种临床上监测血流动力学技术,将经肺温度稀释法与动脉波动曲线分析技术结合,不仅可全面反映血流动力学参数,还可监测心脏舒缩功能及生理变化^[3,4],且操作简单,对机体的创伤较小,不受机体呼吸和心脏功能的影响,有助于提高手术的成功率,降低术后并发症的发生。当前,PICCO 技术多应用于危重、婴幼儿患者^[5,6],但用于老年髋关节手术麻醉过程仍少有报道。本研究在老年髋关节手术中采用 PICCO 监测血流动力学,并与常规监测比较,现将结果报道如下。

1 资料与方法

1.1 一般资料

收集上海交通大学医学院附属同仁医院 2014 年 1 月~2016 年 6 月收治的 106 例老年髋关节手术患者,排除严重的心肺肾脑等系统功能障碍者。其中,男 71 例,女 35 例;年龄 50~78,平均(61.8±6.5)岁;美国麻醉医师协会(ASA)II~IV 级;骨折内固定 41 例,人工股骨头置换术 35 例,全髋关节置换术 30 例;合并症:高血压 26 例,心电图异常 24 例,糖尿病 10 例,冠心病者 9 例。本研究经我院伦理学委员会审议通过,患者及家属均签署知情同意书。按照随机数字表将 106 例患者分为 PICCO 组和常规组,每组各 53 例。两组患者性别、年龄及手术类型等差异具无统计学意义($P>0.05$),具有可比性。

1.2 方法

患者入室后,常规连接多功能监测仪,监测心电图(electrocardiograph, ECG)、收缩压(systolic blood pressure, SBp)、舒张压(diastolic blood pressure, DBp)、血氧饱和度(oxygen saturation, SpO₂)、HR。所有患者均采用全气管插管静脉全麻,静脉注

射咪达唑仑 0.1 mg/kg,顺阿曲库铵 0.15~0.3 mg/kg、舒芬太尼 0.3 μg/kg 诱导麻醉,同时以丙泊酚 6~10 mg/(kg·h)靶控输注,以瑞芬太尼 0.5 μg/(kg·min)持续输注,当患者意识完全消失后静注顺阿曲库铵 0.15 mg/kg/h 维持麻醉。PICCO 组股动脉穿刺放置 PICCO 专用带特殊温度探头的压力监测管,颈内静脉放置中心静脉导管,并接 PICCO 监测仪(德国 Pulsion 公司生产)。常规组放置中心静脉导管和动脉导管监测血流动力学。

1.3 观察指标

① 血液动力学指标:记录麻醉诱导(T0)、麻醉诱导后(T1)、术毕(T2)患者的平均动脉压(MAP)、中心静脉压(CVP)、心率(HR)、心指数(CI)、血管外肺水指数(ELWI)、胸腔内血容量指数(ITBI)及肺血管通透性指数(PVPI)。② 液体入量:记录两组患者术后前 3 天的补液量;③ 术后并发症:观察两组患者围手术期并发症情况。

1.4 统计学方法

应用 SPSS 17.0 软件包进行统计学分析,计量资料比较采用 t 检验,计数资料比较采用 χ^2 检验,以 $P<0.05$ 视为差异有统计学意义。

2 结果

2.1 两组不同时间点血流动力学的变化比较

与 T0 时点比较,PICCO 组 T1 时点的 MAP、CVP、CI、ITBI 明显降低,HR 明显升高,差异均有统计学意义($P<0.05$);T2 时点 MAP、CVP、CI 较 T1 时点明显升高,HR 明显下降,基本恢复至 T0 水平,差异均有统计学意义($P<0.05$)。两组 T0、T1 时刻各血流动力学指标无显著性差异,但 PICCO 组 T2 时刻各血流动力学指标均明显优于常规组,差异均有统计学意义($P<0.05$)。见表 1。

表 1 两组不同时间点血流动力学的变化比较($\bar{x}\pm s$)

Table 1 Comparison of the changes of hemodynamics between two groups at different time points($\bar{x}\pm s$)

Index	T0	T1	T2	T0	T1	T2
MAP(mmHg)	83.5±14.5	67.9±13.5 [▲]	78.4±10.5 ^{*#}	83.3±14.0	65.1±12.6 [▲]	73.4±13.3 [*]
CVP(mmHg)	14.4±3.3	10.8±2.6 [▲]	12.2±2.8 ^{*#}	13.9±3.5	10.3±2.3 [▲]	10.9±2.7 [*]
HR(bpm)	64.7±11.9	80.2±4.3 [▲]	71.5±3.4 ^{*#}	64.1±12.5	82.1±5.5 [▲]	75.8±4.6 [*]
CI(L·min ⁻¹ ·m ⁻²)	4.6±1.3	3.7±1.6 [▲]	5.1±2.1 ^{*#}	4.3±1.6	3.5±1.4 [▲]	5.5±1.8 [*]
ELWI(mL/m ²)	11.2±2.4	10.4±4.7	12.9±3.1 ^{*#}	11.4±2.5	10.1±4.5	11.6±3.5 [*]
ITBI(mL/m ²)	1118.2±109.6	960.9±101.2 [▲]	915.2±96.3 ^{*#}	1134.5±101.7	944.6±91.7 [▲]	887.2±84.0 [*]
PVPI	2.4±0.4	2.2±0.7	3.1±0.9 ^{*#}	2.4±0.5	2.1±0.6	3.4±0.7 [*]

Note: Compared with T0, [▲] $P<0.05$; Compared with T1, ^{*} $P<0.05$; Compared with general, [#] $P<0.05$.

2.2 两组患者术后补液量比较

PICCO 组术后前 3 天的液体入量明显少于常规组,差异均有统计学意义($P<0.05$)。见表 2。

2.3 ELWI 与 PICCO 组液体入量的相关性分析

Pearson 线性相关分析显示:ELWI 与 PVPI、ITBI 呈显著正相关($r=0.732, 0.813, P<0.05$),与 PICCO 组液体入量也有显著相关性($r=0.681, P<0.05$)。

2.4 两组患者术后并发症发生情况的比较

术后,PICCO 组的肺部感染、心血管系统(心律失常、低血压、高血压)的发生率均显著低于常规组,差异均有统计学意义($P<0.05$)。两组住院期间均无死亡病例。见表 3。

3 讨论

老年患者对麻醉及手术的耐受性明显下降,且血流动力学

表 2 两组患者术后补液量比较($\bar{x} \pm s$, mL)Table 2 Comparison of the postoperative fluid intake between two groups($\bar{x} \pm s$, mL)

Group	N	1st day	2nd day	3rd day
PICCO group	53	3348.2 $\pm$ 421.3	2617.2 $\pm$ 389.6	1710.9 $\pm$ 278.2 [▲]
General group	53	4262.6 $\pm$ 552.3	3522.0 $\pm$ 452.4	2618.5 $\pm$ 367.3
P		<0.05	<0.05	<0.05

表 3 两组术后并发症发生情况的比较[例(%)]

Table 3 Comparison of the incidence of postoperative complications between two groups[n(%)]

Groups	N	Pulmonary infection	Embolus formation	Cardiovascular system	Urinary system infection
PICCO group	53	0(0)	1(1.9)	2(3.8)	3(5.7)
General group	53	6(11.3)	3(5.7)	8(15.1)	5(9.4)
P		<0.05	>0.05	<0.05	>0.05

的不稳定使麻醉的风险性增加,从而导致此类患者在手术麻醉及围手术期并发症的发生率、病死率升高。统计数据显示 70 岁以上高龄患者与手术相关的死亡率增加 3 倍,其中 2%的患者与麻醉有关^[7]。另外,髋关节手术患者多为外伤所致,常合并失血性休克,手术中易出现血流动力学紊乱。目前,临床对老年患者的麻醉要求主要有三点:减少应激反应、稳定血流动力学、防止呼吸抑制^[8,9]。因此,围手术期准确监测血流动力学的改变、积极合理的液体复苏对于改善患者预后具有重要意义^[10-12]。

PICCO 监测是一种微创、低危险、连续监测心输出量技术,操作简便,可直接监测容量并且实现量化^[13-16]。其工作机理是将经肺温度稀释技术与动脉脉搏波型曲线下面积分析技术相结合。麻醉药物可对患者的心肌收缩力产生一定影响,其程度与患者术前的功能、麻醉药物的剂量与种类等密切相关。本研究通过对患者的 PICCO 监测与统一的麻醉管理发现与王丽君等^[17]、Feltracco 等^[18]研究结果一致。T0 时点比较,T1 时点的 MAP、CVP、CI 明显降低,HR 明显升高($P<0.05$),与说明在麻醉药物的作用下,心肌收缩力明显减弱。而麻醉诱导后,ITBI 的降低提示麻醉导致外周血管扩张,进一步加重了血容量的不足,同时也表明手术期间利用 PICCO 监测并补足血容量的重要性^[19-22]。PICCO 组 T2 时刻各血流动力学指标均明显优于常规组($P<0.05$),说明 PICCO 监测指标敏感性更高,有助于维持血流动力学的稳定性,减少患者机体损伤,提高治疗效果。T2 时点 MAP、CVP、CI 较 T1 明显升高,HR 明显下降,基本恢复至正常水平。本组病例在 PICCO 的监测下,及时调整麻醉用药剂量,并补充血管活性药物和有效血容量,从而维持血流动力学的稳定。

老年患者的血管调节能力、功能储备均有所减弱,且常伴有心功能不全,麻醉及手术出血均可造成血压下降,而短时间内过快补液又会增加心力衰竭的风险。ELWI 指分布于肺血管外的液体,是反映心肺功能的一个重要指标,可有效反映肺水肿的严重程度^[23-26]。李军等^[27]研究表明 ELWI 监测对危重患者的病情变化及预后评估有重要的价值。本研究显示 PICCO 组术后前 3 天的液体入量明显少于常规组 ($P<0.05$),ELWI 与 PVPI、ITBI、液体入量均呈高度正相关($P<0.05$),且术后肺部感染及心血管并发症的发生率也明显降低,说明 PICCO 监测有

助于准确评估失血量,实现补液的精细化控制及早期血流动力学的优化,从而减少围术期并发症的发生,提高手术成功率^[28-30]。

综上所述,老年髋关节手术中普遍存在血流动力学紊乱,PICCO 持续监测可及时准确地掌握血流动力学状态参数,指导临床麻醉和围术期液体管理,维持患者的循环于最佳状态,减少术中术后不良并发症的发生,改善患者预后。

参考文献(References)

- [1] 杨东辉. 高龄髋关节手术麻醉的相关分析[J] 中国医药指南, 2013, 11(14): 156-158
Yang Dong-hui. Correlation analysis of anesthesia in senile hip surgery[J]. Guide of China Medicine, 2013, 11(14): 156-158
- [2] Goranović T, Adam VN, Grizelj-Stojić E, et al. Current practice of hemodynamic monitoring with PiCCO in a single general surgical ICU in a university hospital a short report [J]. Signa Vitae, 2017, 13 (SUPPL 1): 61-64
- [3] 阎俊, 滑晓娟. PICCO 容量监测在外科重大手术患者中的应用与护理[J]. 基层医学论坛, 2016, 20(7): 990-991
Yan Jun, Hua Xiao-juan. Application and nursing of PICCO volume monitoring in the patients with major surgery[J]. The Medical Forum, 2016, 20(7): 990-991
- [4] 郭飞鹤, 胡春华. 脉搏指示连续心输出量监测技术临床应用进展[J]. 南昌大学学报(医学版), 2014, 11(3): 100-103
Guo Fe-he, Hu Chun-hua. Clinical application of Pulse indicating continuous cardiac output monitoring[J]. Acta Academiae Medicinae Jiangxi, 2014, 11(3): 100-103
- [5] 孟蕾, 于湘友. PICCO 系统临床应用进展[J]. 中华实用诊断与治疗杂志, 2011, 25(1): 3-5
Meng lei, Yu Xiang-you. Clinical application progress of PICCO system[J]. Journal of Chinese Practical Diagnosis and Therapy, 2011, 25(1): 3-5
- [6] 伍义, 马月丹, 吴寿坤. PICCO 容量性指标在感染性休克液体复苏中的临床应用[J]. 现代中西医结合杂志, 2013, 22(1): 16-17, 53
Wu Yi, Ma Yue-dan, Wu Shou-kun. Clinical application of PICCO volume indexes in fluid resuscitation of septic shock [J]. Modern Journal of Integrated Traditional Chinese and Western Medicine, 2013, 22(1): 16-17, 53
- [7] Sairyo K, Matsuura T, Higashino K, et al. Surgery related

- complications in percutaneous endoscopic lumbar discectomy under local anesthesia [J]. *The Journal of Medical Investigation*, 2014, 61 (4): 264-269
- [8] 高伟峰,周浩,陈策,等. 不同全身麻醉药物在高龄手术患者麻醉诱导中的应用对比[J]. *中华全科医学*, 2015, 13(2): 213-215
Gao Wei-feng, Zhou Hao, Chen Ce, et al. A Comparison of effectiveness of three anesthetic agents in induction of general anesthesia in elderly surgical patients [J]. *Chinese Journal of General Practice*, 2015, 13(2): 213-215
- [9] Salk Y, Yazcolu D, Ciekler O, et al. Investigation of Effects of Epidural Anaesthesia Combined with General Anaesthesia on the Stress Response in Patients Undergoing Hip and Knee Arthroplasty [J]. *Turk J Anaesthesiol Reanim*, 2015, 43(3): 154-161
- [10] 宋志,金红旭,李俊丁,等. 脉搏指示连续心排量监测 PiCCO 技术在骨盆骨折患者血流动力学监测中的临床应用[J]. *海南医学院学报*, 2013, 8(3): 220-223
Song Zhi, Jin Hong-xu, Li Jun, et al. Clinical application of pulse-indicated continuous cardiac output technique in hemodynamic monitoring of patients with pelvic fractures [J]. *China Journal of Emergency Resuscitation and Disaster Medicine*, 2013, 8(3): 220-223
- [11] 彭甫圣,付珍红. 不同麻醉方法对老年患者下肢手术时对血小板及血流动力学的影响[J]. *血栓与止血学*, 2016, 22(1): 94-95, 98
Peng Fu-sheng, Fu Zhen-hong. Effect of Different Methods of Anesthesia for the Elderly patients with Lower limb Operation on Platelet and Hemodynamics [J]. *Chinese Journal of Thrombosis and Hemostasis*, 2016, 22(1): 94-95, 98
- [12] Cecconi M, De Backer D, Antonelli M, et al. Consensus on circulatory shock and hemodynamic monitoring. Task force of the European Society of Intensive Care Medicine[J]. *Intensive Care Med*, 2014, 40: 1795-1815
- [13] Cannesson M, Pestel G, Ricks C, et al. Hemodynamic monitoring and management in patients undergoing high risk surgery: a survey among North American and European anesthesiologists [J]. *Crit Care*, 2011, 15(12): R197
- [14] Chang W, Sun L, Ma N, et al. Discuss the Value of PICCO and Echocardiography in Terms of Hemodynamic Monitoring [J]. *RADS Journal of Pharmacy and Pharmaceutical Sciences*, 2016, 4 (1): 2311-4673
- [15] Preau S, Dewavrin F, Demaeght V, et al. The use of static and dynamic hemodynamic parameters before volume expansion: A prospective observational study in six French intensive care units[J]. *Anaesth Crit Care Pain Med*, 2016, 35(10): 93-102
- [16] Hofkens PJ, Verrijcken A, Merveille K, et al. Common pitfalls and tips and tricks to get the most out of your transpulmonary thermodilution device: results of a survey and state-of-the-art review [J]. *Anesthesiol Intensive Ther*, 2015, 47(16): 89-116
- [17] 王丽君,应江明,斯小龙,等. 连续心排量技术监测全麻联合硬膜外麻醉对老年下肢骨折手术患者血流动力学的影响[J]. *中华全科医学*, 2017, 15(2): 255-257, 285
Wang Li-jun, Ying Jiang-ming, Si Xiao-long, et al. Influence of combined general-epidural anesthesia on hemodynamic parameters after surgery for fractures of the lower extremity in elderly patients by using pulse-indicated continuous cardiac output monitoring [J]. *Chinese Journal of General Practice*, 2017, 15(2): 255-257, 285
- [18] Feltracco P, Biancofiore G, Ori C, et al. Limits and pitfalls of hemodynamic monitoring systems in liver transplantation surgery[J]. *Minerva Anesthesiol*, 2012, 78(6): 1372-1384
- [19] 王绍林,张进,何磊,等. PiCCO 血流动力学监测在心脏手术麻醉诱导期应用评价 [J]. *河北联合大学学报 (医学版)*, 2013, 15(2): 153-155
Wang Zhao-lin, Zhang Jin, He Lei, et al. Evaluation of hemodynamic measurement with PICCO during induction of anesthesia in cardiosurgery [J]. *Journal of Hebei United University (Health Sciences)*, 2013, 15(2): 153-155
- [20] Boulain T, Boissrame-Helms J, Ehrmann S, et al. Volume expansion in the first 4 days of shock: a prospective multicentre study in 19 French intensive care units [J]. *Intensive Care Med*, 2015, 41 (23): 248-256
- [21] 徐昕晔,祖凌云,高炜,等. 脉搏指示连续心排量监测在心血管疾病中的应用[J]. *中华心脏与心律电子杂志*, 2014, 2(3): 54-55
Xu Xin-hua, Zu Lin-yun, Gao Wei, et al. Pulse indicates a continuous cardiac output monitoring application in cardiovascular disease [J]. *Chinese Journal of Heart and Heart Rhythm*, 2014, 2(3): 54-55
- [22] Saugel B, Malbrain ML, Perel A. Hemodynamic monitoring in the era of evidence-based medicine[J]. *Crit Care*, 2016, 20(23): 401
- [23] Watson X, Cecconi M. Hemodynamic monitoring in the perioperative period: the past, the present and the future [J]. *Anaesthesia*, 2017, 72(Suppl 1): 7-15
- [24] Geisen M, Rhodes A, Cecconi M. Less-invasive approaches to perioperative hemodynamic optimization [J]. *Curr Opin Crit Care*, 2012, 18(12): 377-384
- [25] Wernly B, Lichtenauer M, Franz M, et al. Pulse contour cardiac output monitoring in acute heart failure patient: Assessment of hemodynamic measurements [J]. *Wien Klin Wochenschr*, 2016, 128 (12): 864-869
- [26] Mutoh T, Kazumata K, Ishikawa T, et al. Performance of bedside transpulmonary thermodilution monitoring for goal-directed hemodynamic management after subarachnoid hemorrhage[J]. *Stroke* 2009, 40(21): 2368-2374
- [27] 李军,支永乐,秦英智,等. 以血管外肺水指数为导向的危重患者的容量评估[J]. *中华危重病急救医学*, 2015, 27(1): 33-37
Li Jun, Zhi Yong-le, Qin Ying-zhi, et al. Assessment of fluid volume in critically ill patients with extravascular lung water index [J]. *Chinese Critical Care Medicine*, 2015, 27(1): 33-37
- [28] Yuanbo Z, Jin W, Fei S, et al. ICU management based on PiCCO parameters reduces duration of mechanical ventilation and ICU length of stay in patients with severe thoracic trauma and acute respiratory distress syndrome[J]. *Ann Intensive Care*, 2016, 6(11): 113-118
- [29] Funcke S, Sander M, Goepfert MS, et al. ICU-CardioMan Investigators. Practice of hemodynamic monitoring and management in German, Austrian, and Swiss intensive care units: the multicenter cross-sectional ICU-CardioMan Study[J]. *Ann Intensive Care*, 2016, 6 (23): 49-54
- [30] Gidwani UK, Goel S. The Pulmonary Artery Catheter in 2015: The Swan and the Phoenix[J]. *Cardiol Rev*, 2016, 24(10): 1-13