ORIGINAL RESEARCH

# Analysis of Results of Continuous Invasive Arterial Blood Pressure Monitoring in Postoperative Patients

Xin Li, BM; Haiyan An, BM; Yi Zhao, BM; Li Tang, BM; Jing An, BM; Zhenyang Chen, BM; Haijuan Hu, PhD


## ABSTRACT

**Objective** • In patients with postoperative circulatory instability, the exploration of invasive arterial blood pressure (IABP) monitoring is of great significance because it can provide real-time cardiovascular function information and help medical staff to better assess and manage the patient's circulatory status. To explore the value of IABP monitoring for patients with postoperative circulatory instability in the postanesthesia care unit (PACU).

**Methods** • From January to December 2021, 160 postoperative patients with circulatory instability were randomly divided into a control group and a study group (80 patients in each group). A random number sequence is generated through a random number table, and random numbers are distributed to different patients to achieve random grouping. SPSS was used for data processing and statistical analysis, *t* test was used for continuous variables, chi-square test was used for count data, and the significance level was $P < .05$.We compared various parameters, such as systolic blood pressure (SBP), PACU observation time, arterial partial pressure of oxygen ($PaO_2$), total hospitalization time, heart rate (HR), arterial partial pressure of carbon dioxide ($PaCO_2$), re-intubation rate, mean arterial pressure (MAP), adverse events, and blood oxygen saturation ($SaO_2$), between the two groups. Flow cytometry was used to analyze changes in immune lymphocyte subsets in the patient's peripheral blood.

**Results** • During the postoperative observation period, there were no significant differences in SBP, $PaCO_2$, HR, $SaO_2$, MAP, and $PaO_2$ between the two groups ($P > .05$)The study group showed higher SBP, SaO2, MAP, and $PaO_2$, and lower HR and $PaCO_2$ compared to the control group ($P < .05$). The study group also had shorter PACU observation time, total hospitalization time, and a lower re-intubation rate compared to the control group ($P < .05$). There was no significant difference in the overall incidence of adverse events between the two groups (7.50% vs 3.75%) ($P > .05$). The study group showed significantly higher proportions of lymphocytes, CD3+ T cells, CD3+ CD4+ T cells, and CD3+ CD4+/CD3+ CD8+ ratio compared to the control group ($P < .05$). This change may reflect the patients with a positive response of the immune system, help to resist disease progress and infection.

**Conclusion** • IABP monitoring can continuously, dynamically and accurately collect arterial blood pressure data of patients with postoperative circulatory instability, contributing to the recovery of immune competence in patients to help formulate the best clinical treatment and intervention plan. The dynamic and accurate arterial blood pressure data collection provided by IABP monitoring contributes not only to immune competence recovery but also to overall patient management and treatment planning. (*Altern Ther Health Med.* 2023;29(8):466-473).


**Xin Li, BM**, Nurse in charge; Department of Critical Care Medicine, The Second Affiliated Hospital of Xingtai Medical College, Xingtai, China. **Haiyan An, BM**, Nurse in charge; Operation Room, Chengde Central Hospital, Chengde, China. **Yi Zhao, BM**, Nurse in charge; Operating Room, Hebei Eye Hospital, Xingtai, China. **Li Tang, BM**, Nurse in charge; Medical examination center, The Second Affiliated Hospital of Xingtai Medical College, Xingtai, China. **Jing An, BM**, Nurse in charge; Clinical Laboratory, The Second Affiliated Hospital of Xingtai Medical College, Xingtai, China. **Zhenyang Chen, BM**, Nurse in charge; Pharmacy, The Second Affiliated Hospital of Xingtai Medical College, Xingtai, China. **Haijuan Hu, PhD,** Nurse in charge; ICU Dept. 1, Chengde City Central Hospital, Chengde, China.

*Corresponding author: Haijuan Hu, PhD*
*E-mail: huhaijuan19810925@126.com*

## INTRODUCTION

Continuous monitoring is of great significance in patients with postoperative circulatory instability, because this monitoring can capture changes in the patient's circulatory status in real time, help early identification and intervention of possible complications, and improve patient safety and recovery speed. However, in this context, noninvasive arterial pressure (NIAP) monitoring faces several challenges and limitations. Although NIAP monitoring does not require the insertion of an arterial catheter, it is affected by factors such as local tissue compression and external interference, which may lead to inaccurate monitoring data. Especially in critically ill patients, whose circulatory status may change rapidly and complexly, more accurate and continuous monitoring methods are needed to capture these changes. Therefore, in order to better guide clinical decision-making and provide effective treatment, it is of great significance to study and explore more accurate and reliable monitoring methods in patients with postoperative circulatory instability.

NIAP characterized by simple operation, non-invasiveness, good repeatability and high patient acceptance is a widely-used clinical monitoring method. However, it cannot achieve satisfactory results for critically ill patients who need accurate and continuous arterial blood pressure monitoring.[1] With acute onset, rapid progression, great harmfulness, poor prognosis and difficult clinical treatment, postoperative circulatory instability is common in patients with cardiovascular and cerebrovascular diseases and critically ill patients. Improper treatment intervention may lead to disability or even death.[2] Postoperative circulatory instability is often caused by factors such as surgical trauma, anesthesia drugs, and fluid imbalance, especially in patients with cardiovascular and cerebrovascular diseases and critically ill patients. This phenomenon can lead to serious complications such as cardiac events and multi-organ dysfunction, adversely affecting the recovery and prognosis of patients. Therefore, reducing circulatory instability is of great clinical significance to these patients, which will help improve treatment effects and reduce medical burden. Continuous invasive arterial blood pressure (IABP) monitoring can more accurately and objectively monitor the arterial blood pressure of patients with postoperative circulatory instability, by which the data can be collected accurately and continuously, thereby helping accurate clinical evaluation of patients' circulatory function and disease development trend.[3,4] IABP monitoring is based on continuous measurement of the patient's arterial pressure in order to monitor changes in circulatory function in real time. The reason for investigating continuous IABP monitoring as a solution is its ability to provide more precise and accurate circulatory information, especially in patients with postoperative circulatory instability. In contrast, noninvasive arterial pressure (NIAP) monitoring is interfered by many factors, such as body position changes, external noise, and skin conditions, which may lead to inaccurate measurements. IABP monitoring bypasses these interfering factors by directly connecting to the arterial vessel, providing more stable and accurate data, which helps to better assess the patient's circulatory status and disease progression. Through this study, we aimed to investigate the value and benefit of implementing IABP monitoring in the postanesthesia recovery unit (PACU) of your hospital for patients with postoperative circulatory instability in 2021. By deeply discussing the application of IABP monitoring in solving the problem of postoperative circulatory instability, we aim to provide a more accurate method of circulatory monitoring for clinical practice in order to better understand disease progression and guide effective treatment decisions.

## PATIENTS AND METHODS

### Patients

From January 2021 to December 2021, 160 patients with postoperative circulatory instability in the Second Affiliated Hospital of Xingtai Medical College were selected and divided into a control group and a study group using a random number table, with 80 cases in each group. Participant selection was based on strict inclusion and exclusion criteria, taking into account the specific characteristics of patients with postoperative circulatory instability. Participants were randomly divided into control and study groups, and the randomization process was performed using a random number table. This random grouping helps eliminate individual differences and bias, making research results more reliable and comparable. The control group received traditional non-invasive arterial blood pressure monitoring (NIAP), while the study group received invasive IABP monitoring to compare the effect and application value of the two monitoring methods in patients with postoperative circulatory instability.

Inclusion criteria were set as follows: (1) Patients with hemodynamic instability after surgical treatment;[5] (2) those aged ≥ gede ami, (3) those receiving general anesthesia surgery in our hospital; 4) those who and whose families were fully informed of the research contents. Exclusion criteria were set as follows: (1) Patients complicated with systemic lupus erythematosus, acquired immune deficiency syndrome, dermatomyositis, exudative dermatitis, drug eruption or other serious skin diseases; (2) critically ill patients with multiple organ failure; 3) those with American Society of Anesthesiologists (ASA)[6] grade ≥ IV. The Ethics Committee of The Second Affiliated Hospital of Xingtai Medical College has approved this study. Inclusion criteria included patients with postoperative circulatory instability following specific cardiovascular and cerebrovascular procedures, and individuals between the ages of 18 and 75 years. Exclusion criteria were selected based on disease characteristics, such as excluding autoimmune diseases such as systemic lupus erythematosus, to ensure that the focus of the study was on patients with postoperative circulatory instability. In addition, the exclusion of patients with American Society of Anesthesiologists grade IV and above is based on the fact that these patients often have serious underlying diseases that may affect the accuracy and effectiveness of monitoring and intervention. The selection of these criteria helps to ensure the internal consistency and external applicability of the research.

### Methods

All patients underwent arterial blood pressure monitoring after entering the anesthesia recovery room at the end of the operation. Then targeted treatment and intervention were performed according to the results of arterial blood pressure monitoring: (1) Hypotension: The causes of hypotension and its risk factors were investigated. If hypotension was caused by hypovolemia, crystal fluid and/or blood products should be given to replenish blood volume in time, and then the patient's signs were dynamically monitored to evaluate blood volume improvement. If hypotension was caused by blockage of venous return or dilatation of blood vessels, volume replacement or alpha agonists should be given. If hypotension was caused by abnormal cardiac output, symptomatic treatment such as dopamine, adrenaline, calcium channel blockers, and diuretics should be performed. (2) Hypertension, arrhythmia, etc.: The treatment principles were the same as those for hypotension. After the investigation of the causes of hypertension and arrhythmia, the symptoms should be controlled by β-blockers, calcium channel blockers or anti-arrhythmia drugs. Arterial blood pressure was continuously monitored in all patients until stable circulation was restored.

The control group underwent NIAP monitoring: A non-invasive blood pressure monitor (SDXY01, Beijing Seston Technology Co., LTD., Beijing, China) was used for arterial blood pressure monitoring. The cuff of the monitor was tied to the patient's left arm and adjusted so that two fingers could be inserted. Automatic blood pressure measurement was performed 30 min/time in the daytime and 60 min/time in the nighttime. The study group underwent IABP monitoring: An invasive blood pressure monitor (Shanghai Jumu Medical Instrument Co., LTD., AIQS6, Shanghai, China) was used for arterial blood pressure monitoring. Radial artery, dorsal foot artery or femoral artery was selected for puncture in priority order. Dorsal foot artery or femoral artery was selected for Allen's test-positive patients, with a rigid medical connecting tube as the extension tube (length: 0.8 m, inner diameter: 4 mm). During the monitoring process, the catheter was kept unblocked using normal saline, and the patient's blood pressure and waveform were continuously monitored to confirm and eliminate waveform interference factors. During IABP monitoring, the local skin was disinfected with povidone iodine, sterile towels wrapped the three-way tube, and the puncture site was pasted with 3M transparent adhesive tapes. The tube and sterile towels were replaced every 72 h, and the normal saline was replaced every 24 h. Thrombosis, local bleeding and subcutaneous hematoma were routinely prevented, and air tightness and liver and kidney function were monitored. Arterial blood pressure monitoring uses a long, thin catheter inserted into the patient to continuously measure blood pressure, especially during surgery. Intervention includes adjusting drug doses based on monitoring results to maintain the target blood pressure range, and individualized management can improve safety. This approach helps maintain circulatory stability, reduces the risk of cardiovascular events, and provides real-time information to guide treatment.

### Observation Indicators

**Hodynamic parameters**. Systolic blood pressure (SBP), total hospitalization time, heart rate (HR), reintubation rate, mean arterial pressure (MAP). SBP, HR and MAP were compared between the two groups at the time of PACU entry (T1) and 60 min later (T2).

**Blood gas analysis indexes**. PACU observation time, partial pressure of blood oxygen ($PaO_2$), , partial pressure of carbon dioxide ($PaCO_2$), , adverse events and oxygen saturation ($SaO_2$) were compared between the two groups. $PaCO_2$, $SaO_2$ and $PaO_2$ were compared between the two groups at T1 and T2.

Clinical indicators PACU observation time, total hospitalization time and reintubation rate were compared between the two groups. Adverse events, local bleeding, subcutaneous hematoma, catheter prolapse, and limb numbness were compared between the two groups. Immune lymphocyte subsets (lymphocytes, CD3 + T lymphocytes, CD3 + CD4 + T lymphocytes, CD3 + CD8 + T lymphocytes, CD3 + CD4 + / CD3 + CD8 + ratio, cd3-cd19 + B cells, and CD3-CD56 + 16 + NK cells) in the peripheral blood of the patients were determined by flow cytometry.

### Statistical analysis

Statistical Product and Service Solutions (SPSS) 22.0 (IBM, Armonk, NY, USA) was used for data analysis. Use SPSS to efficiently process and analyze complex medical datasets for accurate research results. The patient's age, body mass index, PACU observation time, total hospitalization time, SBP, $PaO_2$, HR, $PaCO_2$, MAP and $SaO_2$ were analyzed by $t$ test. The patient's gender, type of circulatory instability, incidence of adverse events and re-intubation rate were analyzed by $\chi^2$ test. In terms of data presentation, continuous variables will be expressed as mean ± standard deviation, which helps to clearly describe the central tendency and variability of variables. Categorical variables will be expressed as percentages to effectively show the distribution across categories. $P < .05$ was considered statistically significant.

## RESULTS

### Comparison of general data between the two groups

Table 1 presents a comparison of general data between the study group and the control group. The study group consisted of 80 patients with a mean age of 53.43 years and a mean body mass index (BMI) of 21.26 kg/m$^2$. Among these patients, 46 (57.50%) were male, and 34 (42.50%) were female. Additionally, 46 (57.50%) patients in the study group had hypotension, 21 (26.25%) had hypertension, and 13 (16.25%) had arrhythmia as the type of circulatory instability. In the control group, there

**Table 1.** Comparison of general data between the two groups

| Group | n | Age (years) | Body mass index (kg/m$^2$) | Gender [n (%)] | | Type of circulatory instability [n(%)] | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Male | Female | Hypotension | Hypertension | Arrhythmia |
| Study group | 80 | 53.43 | 21.26 | 46(57.50) | 34(42.50) | 46(57.50) | 21(26.25) | 13(16.25) |
| Control group | 80 | 52.55 | 21.37 | 43(53.75) | 37(46.25) | 44(55.00) | 24(30.00) | 12(15.00) |
| $t/\chi^2$ | | 1.28 | 0.47 | 0.23 | | 0.28 | | |
| $P$ value | | .20 | .64 | .63 | | .87 | | |

**Table 2.** Comparison of hemodynamic indexes between the two groups ($\bar{x} \pm s$)

| Group | n | SBP (mmHg) T1 | SBP (mmHg) T2 | HR (beats /min) T1 | HR (beats /min) T2 | MAP (mmHg) T1 | MAP (mmHg) T2 |
|---|---|---|---|---|---|---|---|
| Study group | 80 | 81.42 | 103.42[a] | 109.43 | 74.42[a] | 61.13 | 74.15[a] |
| Control group | 80 | 82.17 | 94.46 | 110.20 | 79.65 | 60.94 | 69.87 |
| *t* | | 0.89 | 12.53 | 1.01 | 8.10 | 0.36 | 6.44 |
| *P* value | | 0.38 | .00 | 0.31 | .00 | 0.72 | .00 |

[a]*P* < .05 compared to the control group.

**Table 3.** Comparison of blood gas analysis indexes between the two groups ($\bar{x} \pm s$)

| Group | n | $PaCO_2$ (mmHg) T1 | $PaCO_2$ (mmHg) T2 | $SaO_2$ (%) T1 | $SaO_2$ (%) T2 | $PaO_2$ (mmHg) T1 | $PaO_2$ (mmHg) T2 |
|---|---|---|---|---|---|---|---|
| Study group | 80 | 47.85 | 39.70[a] | 91.46 | 98.43[a] | 70.43 | 90.21[a] |
| Control group | 80 | 47.94 | 44.59 | 91.57 | 95.56 | 70.55 | 81.46 |
| *t* | | 0.23 | 13.50 | 0.23 | 10.56 | 0.20 | 14.28 |
| *P* value | | .82 | .00 | .82 | .00 | .84 | .00 |

[a]*P* < .05 compared to the control group.

**Table 4.** Comparison of clinical indicators between the two groups

| Group | n | PACU observation time (min) | Total hospitalization time (D) | Re-intubation rate [n (%)] |
|---|---|---|---|---|
| Study group | 80 | 143.43[a] | 8.2643[a] | 2 (2.50) |
| Control group | 80 | 175.53 | 10.783 | 11 (13.75) |
| $t/\chi^2$ | | 17.00 | 9.99 | 5.36 |
| *P* value | | .000 | .000 | .021 |

[a]*P* < .05 compared to the control group.

were also 80 patients with a mean age of 52.55 years and a mean BMI of 21.37 kg/m$^2$. Of these patients, 43 (53.75%) were male, and 37 (46.25%) were female. Among the control group, 44 (55.00%) patients had hypotension, 24 (30.00%) had hypertension, and 12 (15.00%) had arrhythmia as the type of circulatory instability. Statistical analysis using *t* tests or chi-square tests showed no significant differences between the two groups in terms of age, BMI, gender distribution, and type of circulatory instability (hypotension, hypertension, or arrhythmia) (*P* > .05 for all comparisons).

**Comparison of hemodynamic indexes between the two groups**

Table 2 presents a comparison of hem indexes between the study group and the control group. The study group consisted of 80 patients, and their mean systolic blood pressure (SBP) at T1 and T2 was 81.42 mmHg and 103.42 mmHg, respectively. The mean heart rate (HR) at T and T2 was 109. beats/min and 74.423 beats/min, respectively. The mean arterial pressure (MAP) at T1 and T2 was 61.133 mmHg and 74.153 mmHg, respectively.The control group also included 80 patients; their mean SBP at T1 and T2 was 82.17 mmHg and 94.46 mmHg, respectively. The mean HR at T1 and T2 was 110. beats/min and 79.65 beats/min, respectively. The mean MAP at T1 and T2 was 60.94 mmHg and 69.87 mmHg, respectively. Statistical analysis using t-tests showed that were no significant differences between the two groups in terms of SBP at T1 (*P* = .375) and T2 (*P* = .000), HR at T1 (*P* = .313) and T2 (*P* = .000), as as MAP at T1 (*P* = .718) and T2 (*P* = .000). However, the two groups had a significant difference in HR T2 (*P* = .000). This may mean that the treatment or intervention is effective in reducing heart rate and helping to improve the patient's cardiovascular health.

**Comparison of blood gas analysis indexes between the two groups**

Table 3 presents a comparison of blood gas analysis indexes between the study group and control group. The study group consisted of 80 patients, and their mean partial pressure of carbon dioxide ($PaCO_2$) at T1 and T2 was 47.85 mmHg and 39.70 mmHg, respectively. The mean arterial oxygen saturation ($SaO_2$) at T1 and T2 was 91.46% and 98.43%, respectively. The mean partial arterial oxygen ($PaO_2$) pressure at T1 and T2 was 70.43 mmHg and 90.21 mmHg, respectively.The control group also included 80 patients; their mean $PaCO_2$ at T1 and T2 was 47.94 mmHg and 44.59 mmHg, respectively. The mean SaO2 at T1 and T2 was 91.57% and 95.56%, respectively. The mean $PaO_2$ at T1 and T2 was 70.55 mmHg and 81.46 mmHg, respectively.Statistical analysis using t-tests showed that there were no significant differences between the two groups in terms of $PaCO_2$ at T1 (*P* = .818) and T2 (*P* = .000), $SaO_2$ at T1 (*P* = .822) and T2 (*P* = .000), as well as $PaO_2$ at T1 (*P* = .843) and T2 (*P* = .000). However, the two groups had significant differences in $PaCO_2$ at T2 and $PaO_2$ at T2 (*P* = .000). The study group had a lower $PaCO_2$ at T2 and higher $PaO_2$ at T2 compared to the control group. The treatment or intervention received by the study group showed significant results in improving the patient's gas exchange function, and the treatment or intervention had a positive effect on the patient's respiratory system and oxygenation function, which may help improve the patient's respiratory symptoms and oxygen supply, thereby improving the patient's physiological condition.

**Comparison of clinical indicators between the two groups**

Table 4 presents a comparison of clinical indicators between the study group and the control group. The study group consisted of 80 patients, and their mean post-anesthesia care unit (PACU) observation time was 143.43 minutes, while their mean total hospitalization time was 8.2643 days. The re-intubation rate in the study group was 2 out of 80 patients (2.50%).The control group also included 80 patients; their mean PACU observation time was 175.53 minutes, while their mean total hospitalization time was 10.783 days. The re-intubation rate in the control group was 11 out of 80 patients (13.75%). Statistical analysis using *t* tests and chi-square tests showed that there were significant differences between the two groups in terms of PACU observation time (*P* = .000), total hospitalization time (*P* = .000), and re-intubation rate (*P* = .021). The study group had a shorter PACU observation time, shorter total hospitalization time, and lower re-intubation rate compared to the control group. Treatment or intervention has a positive effect on a patient's postoperative recovery and recovery and may help reduce the patient's length of hospital stay and risk of complications.

**Table 5.** Comparison of adverse events between the two groups

| Group | n | Local hemorrhage | Subcutaneous hematoma | Catheter prolapse | Numbness of limbs | Total adverse event rate |
|---|---|---|---|---|---|---|
| Study group | 80 | 3 (3.75) | 2 (2.50) | 1 (1.25) | 0 | 6 (7.50) |
| Control group | 80 | 0 | 0 | 0 | 3 (3.75) | 3 (3.75) |
| $\chi^2$ | | | | | | 0.47 |
| *P* value | | | | | | .49 |

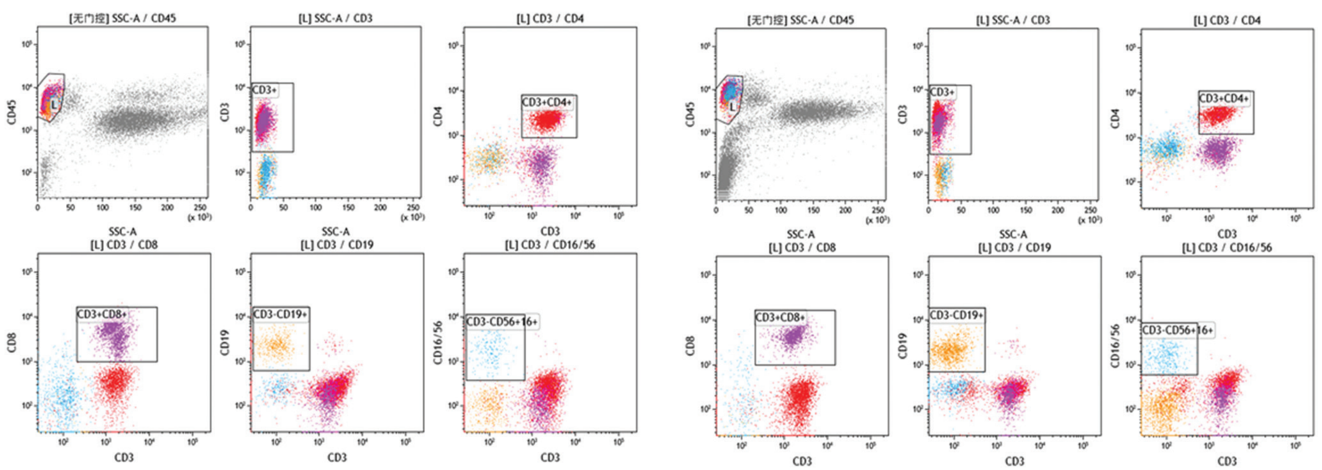
**Table 6.** Comparison of lymphocyte subpopulation immune index recovery between the two groups

| Group | n | lymphocyte | CD3+ T Cells | CD3+ CD4+ T Cells | CD3+ CD8+ T Cells | CD3+CD4+/ CD3+CD8+ | CD3-CD19+ B Cells | CD3-CD56+ 16+ NK Cells |
|---|---|---|---|---|---|---|---|---|
| Study group | 80 | 30.45 ± 3.66[a] | 75.23 ± 5.68[a] | 45.34 ± 3.74[a] | 28.13 ± 2.86 | 1.84±0.24[a] | 10.62 ± 3.11 | 15.24 ± 3.07 |
| Control group | 80 | 28.65 ± 3.85 | 67.16 ± 5.09 | 33.35 ± 3.82 | 29.73 ± 3.15 | 1.25±0.21 | 14.25 ± 3.58 | 18.66 ± 3.49 |
| $t/\chi^2$ | | 3.412 | 6.366 | 10.204 | 0.895 | 7.153 | 0.992 | 1.012 |
| *P* value | | .035 | .015 | .005 | .772 | .009 | .147 | .223 |

[a]*P* < .05 compared to the control group.

**Figure 1.** Schematic diagram of changes in lymphocyte subsets in peripheral blood of two groups of patients detected by flow cytometry. (A) Study group; (B) Control group

**A.** Study group **B**. Control group




**Abbreviations**: L, lymphocyte.

## Comparison of adverse events between the two groups

Common adverse events can include surgery-related problems, drug-related reactions, treatment-related discomfort, device-related problems, allergic or anaphylactic reactions, cardiovascular events, respiratory events, and digestive events. The total incidence of adverse events in the study group was higher than that in the control group (7.50% *vs* 3.75%), but the difference was not statistically significant ($\chi^2$ = 0.471, *P* > .05) (Table 5).

## Comparison of lymphocyte subpopulation immune index recovery between the two groups

Recovery of lymphocyte subpopulation immune index may have an important impact on patient outcomes. Different subsets of lymphocytes play different roles in the immune system, such as the regulatory role of T cells, the production of antibodies by B cells, and the killing function of natural killer cells. Recovery of lymphocyte subpopulation immune index is considered an important predictor of patient outcomes, especially in immunodeficiency diseases or malignant tumor treatment. In the study group, after treatment, the percentage of peripheral blood lymphocytes, the percentage of CD3 + T lymphocytes, the percentage of CD3 + CD4 + T lymphocytes, and the CD3 + CD4 + / CD3 + CD8 + ratio were significantly higher (P < 0.05; However, the proportions of CD3 + CD8 + T lymphocytes, CD3-CD19 + B cells, and CD3-CD56 + 16 + NK cells were not significantly different (*P* > .05).(See in Figure 1 and Table 6). This may indicate that the treatment or intervention has a positive effect on the person's immune function, helping to regulate and enhance the function of immune cells.

## DISCUSSION

Blood pressure is a clinically significant hemodynamic indicator. Scientific and effective monitoring of arterial blood pressure can assist clinicians in accurately assessing the condition and prognosis of patients, optimizing treatment and intervention plans, reducing the risk of progression and mortality, and improving overall treatment outcomes.[7,8] Non-invasive cuff is primarily used for non-invasive arterial pressure (NIAP) monitoring. Despite its simplicity and safety, the accuracy of blood pressure measurement is susceptible to interference from bandage tightness, hypotension, inadequate blood volume, and other factors.[9-11]

NIAP monitoring also has limitations such as poor accuracy, discontinuous blood pressure monitoring, and limb ischemia and numbness, which hinder accurate arterial blood pressure monitoring in patients with postoperative circulatory instability.[11-13] In contrast, invasive arterial blood pressure (IABP) monitoring utilizes invasive technology to implant pressure sensors into patients' arteries.[14,15] Invasive arterial blood pressure monitoring (IABP) also enables real-time monitoring of blood pressure fluctuations to provide immediate feedback on a patient's blood pressure stability, helping to detect and manage blood pressure abnormalities. In addition, IABP monitoring provides accurate and precise blood pressure data, avoiding non-invasive measurement errors. Real-time monitoring of blood pressure fluctuations can also provide information about a patient's hemodynamic status, guide treatment decisions, and monitor treatment effectiveness. Changes do not influence this measurement process in the patient's blood volume and blood pressure. It can continuously and dynamically collect arterial blood pressure data, allowing for more accurate assessment of improving patients' circulatory function and reducing the risk of disease progression and treatment burden.[16-18]

This study monitored 160 patients with postoperative circulatory instability for arterial blood pressure by different methods. According to arterial blood pressure monitoring results, symptomatic treatment and intervention were carried out. The results showed that SBP, MAP, $SaO_2$, and $PaO_2$ were lower than normal values, while HR and $PaCO_2$ were higher than normal values. After arterial blood pressure monitoring and treatment intervention, SBP and MAP were improved in the two groups at 60 min after PACU entry compared with those at 30 min after PACU entry. SBP, MAP, $SaO_2$ and $PaO_2$ in the study group were higher than those in the control group, while HR and $PaCO_2$ were lower than those in the control group, suggesting that IABP monitoring can more accurately monitor blood pressure parameters of patients with postoperative circulatory instability, thus providing scientific references for the development of treatment and intervention plans. It was also found that the PACU observation time and total hospitalization time in the study group were shorter than those in the control group, and the re-intubation rate was lower than that in the control group, indicating that IABP monitoring can shorten both circulation recovery time and treatment time, and lower the risk of tracheal reintubation. In addition, the total incidence of adverse events in the study group was higher than that in the control group (7.50% *vs* 3.75%). Local bleeding, subcutaneous hematoma, and catheter prolapse were the most common adverse events in IABP monitoring, but no statistically significant difference was found between the two groups. In general, IABP monitoring used for patients with postoperative circulatory instability has the following advantages: (1) Firstly, it allows for direct monitoring of dynamic changes in arterial blood pressure through a pressure sensor without affecting artificial pressure, blood volume, blood pressure control drugs, cuff tightness, or cuff width. This provides more objective and accurate monitoring data, which can assist in the development and adjustment of treatment plans[19] (2) Secondly, blood samples for blood gas analysis can be collected at any time during IABP monitoring, eliminating the need for repeated punctures and reducing the impact on the patient's body; (3) Additionally, IABP monitoring enables prompt detection of sudden changes in arterial pressure and facilitates targeted treatment and intervention. The arterial pressure waveform can also be used to assess myocardial contraction ability and guide appropriate therapeutic measures, ultimately benefiting the patient's circulatory function[20,21] However, it is worth pointing out that IABP monitoring is invasive, and it may cause adverse events such as catheter prolapse, local hemorrhage and subcutaneous hematoma formation. Therefore, corresponding nursing interventions should be improved during the use of IABP monitoring to prevent adverse events.

The clinical significance of this study lies in evaluating the effectiveness of IABP monitoring in patients with postoperative circulatory instability, and makes some important findings and conclusions. The use of IABP monitoring can provide more accurate and objective blood pressure monitoring data, avoiding non-invasive measurement errors and other confounding factors. In addition, the results showed that monitoring with IABP shortened postoperative cycle recovery time and total hospital stay, and reduced the risk of tracheal reintubation. Hemodynamic information obtained through IABP monitoring can guide treatment decisions and optimize treatment strategies to improve circulatory function and prognosis in patients. Therefore, this study has important clinical significance for guiding clinical practice and optimizing treatment strategies for patients with postoperative circulatory instability. However, further research is needed to validate these results and assess long-term effects and safety.

The limitations of this study should be acknowledged. Firstly, the study was conducted at a single hospital with a relatively small sample size, which may limit the generalizability of the findings to larger populations or different healthcare settings. Future studies with larger sample sizes and multi-centre collaborations could enhance the external validity of the results. Secondly, potential selection bias may exist. Although randomization was used for group allocation, there could still be inherent biases in the selection process that could impact the accuracy of the results. Further efforts to minimize selection bias, such as rigorous enrollment criteria and blinding procedures, could enhance the validity of the findings. Additionally, other variables or factors that were not measured or controlled for in the study could confound the outcomes. Factors such as comorbidities, medications, and specific surgical procedures could potentially have influenced the results. Drug use is one of the common interventions in clinical practice and can have an impact on patient outcomes. Different drugs may have different pharmacological effects and side effects, which may affect the patient's circulatory function and prognosis. In this study, while the study group may have considered the patient's medications, the potential impact of drug use on the results of the study could not be ruled out. Comorbidities refer to other clinical problems or diseases that arise during the study. These comorbidities may have important implications for patient treatment and prognosis. In this study, the study group may have documented comorbidities in patients, but the potential impact of comorbidities on the results of the study could not be ruled out. Future research could consider incorporating a more comprehensive set of variables to better control for potential confounding factors. Lastly, the study primarily focused on immediate postoperative outcomes such as PACU observation time and total hospitalization time. The long-term effects of IABP monitoring on patient outcomes and prognosis were not assessed. Long-term follow-up studies could provide valuable insights into the sustained benefits or potential risks associated with IABP monitoring.These limitations need to be considered when interpreting findings and guiding clinical practice, and it is hoped that future studies will further validate and refine these findings.

Overall, this study provides new insights into the management of patients with postoperative circulatory instability, highlighting the potential clinical value of IABP surveillance in this patient population. At the same time, it reminds us to carefully consider the influence of confounding factors when interpreting and applying the results of the study.These new insights and contributions have important implications for guiding clinical practice and improving patient outcomes. It is hoped that this study will promote further research in related fields and provide clinicians with more accurate and effective treatment strategies, thereby improving the survival rate and quality of life of patients with postoperative circulatory instability.

## CONCLUSION

IABP monitoring has significant clinical potential in anesthesia recovery in patients with postoperative circulatory instability. By collecting patients' arterial blood pressure data continuously, dynamically and accurately, IABP monitoring can help anesthesiologists develop the best treatment intervention plan, promote the recovery of patients' circulatory function and the enhancement of lymphocyte immune function, reduce the treatment burden of patients, and improve the quality of care.

In clinical practice, we can apply these findings directly to the management of patients with postoperative circulation instability. By adopting IABP monitoring technology, anesthesiologists can more accurately understand the patient's circulatory function and adjust treatment strategies in time to achieve better treatment outcomes. In addition, by monitoring and intervening in patients' circulatory function, we can reduce length of hospital stay, improve patient outcomes, and enhance patients' immune responses.

These findings also have important implications for the broader field of anesthesia and critical care care. In the field of anesthesia, IABP monitoring technology can be used as an effective monitoring tool to provide more accurate data support for circulation management during surgery. In critical care areas, IABP monitoring technology can help intensive care physicians better assess and manage patients with postoperative circulatory instability, improving their survival and quality of life.

## CONFLICT OF INTEREST

The authors have no potential conflicts of interest to report relevant to this article.

## AUTHOR CONTRIBUTIONS

YW and LH designed the study and performed the experiments, QY and WS collected the data, SL, XJ, and LL analyzed the data, YW and LH prepared the manuscript. All authors read and approved the final manuscript. Xin Li and Haiyan An contributed equally to this work.

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## REFERENCE

1. Hill BL, Rakocz N, Rudas Á, et al. Imputation of the continuous arterial line blood pressure waveform from non-invasive measurements using deep learning. *Sci Rep*. 2021;11(1):15755. doi:10.1038/s41598-021-94913-y
2. Kędziora A, Piątek J, Hymczak H, et al. Early postoperative hemodynamic instability after heart transplantation - incidence and metabolic indicators. *BMC Anesthesiol*. 2021;21(1):236. doi:10.1186/s12871-021-01455-x
3. Hernandez G, Messina A, Kattan E. Invasive arterial pressure monitoring: much more than mean arterial pressure! *Intensive Care Med*. 2022;48(10):1495-1497. doi:10.1007/s00134-022-06798-8
4. Kaufmann T, Cox EGM, Wiersema R, et al; SICS Study Group. Non-invasive oscillometric versus invasive arterial blood pressure measurements in critically ill patients: A post hoc analysis of a prospective observational study. *J Crit Care*. 2020;57:118-123. doi:10.1016/j.jcrc.2020.02.013
5. Minokadeh A, Pinsky MR. Postoperative hemodynamic instability and monitoring. *Curr Opin Crit Care*. 2016;22(4):393-400. doi:10.1097/MCC.0000000000000320
6. Rebecca B, William S, Neifert SN, et al. The Use of the American Society of Anesthesiologists (ASA) Classification System in Evaluating Outcomes and Charges Following Deformity Spine Procedures [J]. *Neurosurgery*. 2020;11(10):122-124.
7. Czeszyńska MB, Sontowska A. SpO2, heart rate, and arterial blood pressure during successful or failed application of non-invasive ventilation after delivery - a single-centre study. *Anaesthesiol Intensive Ther*. 2020;52(4):304-311. doi:10.5114/ait.2020.100574
8. Rebesco MR, Pinkston MC, Smyrnios NA, Weisberg SN. A Comparison of Non-Invasive Blood Pressure Measurement Strategies with Intra-Arterial Measurement. *Prehosp Disaster Med*. 2020;35(5):516-523. doi:10.1017/S1049023X20000916
9. Fujii T, Nishiwaki K. Comparing oscillometric noninvasive and invasive intra-arterial blood pressure monitoring in term neonates under general anesthesia: A retrospective study. *Paediatr Anaesth*. 2020;30(12):1396-1401. doi:10.1111/pan.14020
10. Cambiaso-Daniel J, Rontoyanni VG, Foncerrada G, et al. Correlation between invasive and noninvasive blood pressure measurements in severely burned children. *Burns*. 2018;44(7):1787-1791. doi:10.1016/j.burns.2018.03.001
11. Al Sadah ZM, Alfaraj NH, AlAlwan NE, Al Dhaif LH, Khidr AM, Fallatah SM. Assessment of patients' satisfaction with the postanesthesia care unit service at University Hospital in Al Khobar, KSA. *J Taibah Univ Med Sci*. 2022;18(2):217-224. doi:10.1016/j.jtumed.2022.09.012
12. Chen Q, Akande O, Lesnefsky EJ, Quader M. Influence of sex on global myocardial ischemia tolerance and mitochondrial function in circulatory death donor hearts. *Am J Physiol Heart Circ Physiol*. 2023;324(1):H57-H66. doi:10.1152/ajpheart.00478.2022
13. Chen X. Comment on "Sugammadex reversal of muscle relaxant blockade provided less post-anesthesia care unit adverse effects than neostigmine/glycopyrrolate". *J Formos Med Assoc*. 2023;•••:S0929-6646(23)00106-7. doi:10.1016/j.jfma.2023.03.021
14. Grafton G, Tita C, Heuring JJ, et al. Continuous-Flow Intra-Aortic Percutaneous Mechanical Circulatory Support in Heart Failure With Worsening Renal Function. *Circ Heart Fail*. 2023;16(3):e009842. doi:10.1161/CIRCHEARTFAILURE.122.009842
15. Karlas A, Fasoula NA, Katsouli N, et al. Skeletal muscle optoacoustics reveals patterns of circulatory function and oxygen metabolism during exercise. *Photoacoustics*. 2023;30:100468. doi:10.1016/j.pacs.2023.100468
16. Kwon Y, Stafford PL, Enfield K, Mazimba S, Baruch MC; Continuous Noninvasive Blood Pressure Monitoring of Beat-By-Beat Blood Pressure and Heart Rate Using Caretaker Compared With Invasive Arterial Catheter in the Intensive Care Unit. Continuous Noninvasive Blood Pressure Monitoring of Beat-By-Beat Blood Pressure and Heart Rate Using Caretaker Compared With Invasive Arterial Catheter in the Intensive Care Unit. *J Cardiothorac Vasc Anesth*. 2022;36(7):2012-2021. doi:10.1053/j.jvca.2021.09.042
17. Moeslund N, Zhang ZL, Dalsgaard FF, et al. Clamping of the Aortic Arch Vessels During Normothermic Regional Perfusion Does Not Negatively Affect Donor Cardiac Function in Donation After Circulatory Death. *Transplantation*. 2023;107(1):e3-e10. doi:10.1097/TP.0000000000004298
18. Schüßler J, Ostertag J, Georgii MT, et al. Preoperative characterization of baseline EEG recordings for risk stratification of post-anesthesia care unit delirium. *J Clin Anesth*. 2023;86:111058. doi:10.1016/j.jclinane.2023.111058
19. Wu L, Yang Y, Yin Y, Yang L, Sun X, Zhang J. Lung ultrasound for evaluating perioperative atelectasis and aeration in the post-anesthesia care unit. *J Clin Monit Comput*. 2023;•••. doi:10.1007/s10877-023-00994-7
20. Xu L, Zeng Z, Niu C, et al. Normothermic *ex vivo* heart perfusion with NLRP3 inflammasome inhibitor Mcc950 treatment improves cardiac function of circulatory death hearts after transplantation. *Front Cardiovasc Med*. 2023;10:1126391. doi:10.3389/fcvm.2023.1126391
21. Anh DT, Minh HV, Binh HA, et al. Age related differences in acute coronary syndrome: an observation at a central hospital in Vietnam. *J Transl Int Med*. 2021;9(1):32-37. doi:10.2478/jtim-2021-0012

CASE REPORT

# A Case Report of Multiple Renal Calculi Treated With Individualized Homoeopathy

Preeti Lamba, MD(Hom); Ayush Kumar Gupta, MD(Hom)

## ABSTRACT

**Background** • Mineral buildups called kidney stones can be free-floating or affixed to the renal papillae and occur in the renal calyces and pelvis. A major morbidity is associated with the widespread problem of renal stone disease. Open surgical lithotomy and minimally invasive endourological procedures are now the standard for the management of kidney stone symptoms. However, individualized homeopathy (iHOM) has greatly improved treatment of Multiple Renal Calculi.

**Methods** • In the OPD of Dr. D. Y. Patil Homoeopathic Medical College and Research Centre, a 26-year-old female patient with multiple renal calculus was treated homeopathically from August 2021 to January 2022. During the follow-up visits outcome was assessed. To assess whether the changes were due to homoeopathic medicine, an assessment using the modified Naranjo criteria was performed.

**Results** • Over an observation period of 5 months beneficial result from iHOM medicine was seen and so can be used by the physicians in the treatment of Renal Calculi as a complementary health practice.

**Conclusion** • Based on the totality of symptoms, individualized Homoeopathic Medicine (iHOM) Lycopodium Clavatum 30C was given and worked well to dissolve and expel all renal stones. Hence, homeopathy is effective in the fragmentation and ejection of renal calculi and remains one of the most popular treatments for urological problems. (*Altern Ther Health Med.* 2023;29(8):474-477).

**Preeti Lamba,** MD (Hom), Associate Professor; Department of Homoeopathic Materia Medica; Dr. D. Y. Patil Homoeopathic Medical College & Research Center, Pimpri, Pune, Maharashtra; Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, India. **Ayush Kumar Gupta,** MD (Hom), Associate Professor; Department of Homoeopathic Materia Medica; Dr. D. Y. Patil Homoeopathic Medical College & Research Center, Pimpri, Pune, Maharashtra; Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, India.

*Corresponding author: Preeti Lamba,* MD(Hom)
*E-mail: preeti.lamba@dpu.edu.in*

## INTRODUCTION

Urolithiasis is the term for the development of stones in the urinary tract[1], which includes the kidney, ureter, and bladder (KUB). Kidney stones are among the most common urological conditions. One in ten people in India suffers from this condition. Furthermore, the patient's financial burden is enhanced because repeated stone development is common in medical care.[1-4] Although the aetiology is complicated, a sedentary lifestyle plays a significant role. In India, both upper and lower urinary tract stones are common; the frequency varies greatly by region.[6] While stones larger than 7 mm nearly invariably require surgery, stones between 5 and 7 mm have a 50% chance of passing naturally.[7,8] Since non-interventional therapies are the most appealing to patients, alternative medical therapy methods are receiving a lot of attention.[9,10] In a multicentre observational study carried out by the CCRH, New Delhi, Lycopodium Clavatum was found to be one of the most effective medications in the dissolving and expulsion of calculi. The current study supports past research that demonstrated the value of homeopathic therapies for urological diseases.[10]

## PATIENT INFORMATION

A 26- 26-year-old female patient visited the OPD of Dr. D.Y. Patil Homoeopathic Medical College & Research Centre, India, complaining of pain in the left and right iliac region +++ for 2 days. Urine was burning, hot +++ with the presence of blood ++. She frequently felt the urge to urinate, particularly at night ++. The pain was more before urination ++ with sensation as if some urine was held back ++.

### Personal History

**Food/drink-Desires/Aversions**: She had an aversion for bread +++ and a desire for sweets +++.