AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 3, Issue 8, 2025 ISSN (E): 2993-2149

Comparative Evaluation of Spinal and General Combined Anesthesia with Quadratus Lumborum Block in Gynecological Surgeries in Patients with Chronic Heart Failure

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Abstract: In this article the results of a clinical study aimed at objectively evaluating the effectiveness of various balanced anesthesia techniques using regional blocks in gynecological patients with chronic heart failure (CHF) of functional class II–III according to NYHA are presented. A total of 52 patients underwent planned gynecological surgeries, including abdominal hysterectomies or reconstructive-plastic interventions. The anesthetic techniques used included spinal anesthesia (SA) in combination with quadratus lumborum (QL) block and general combined anesthesia with mechanical ventilation and QL-block using reduced concentrations of local anesthetics. It was found that both variants of balanced anesthesia involving QL-block provide reliable hemodynamic stability and antinociceptive protection in patients with CHF.

Keywords: chronic heart failure, spinal anesthesia, general anesthesia, quadratus lumborum block, hemodynamics, antinociceptive protection.

Introduction. Gynecological interventions in patients with chronic heart failure (CHF) are associated with a high anesthetic risk due to the limited compensatory capabilities of the cardiovascular system [1].

Maintaining stable central and peripheral hemodynamic parameters, ensuring adequate gas exchange, and providing effective antinociceptive protection represent key objectives during anesthesia in patients with CHF. Patients with reduced adaptive-compensatory capacity require a thorough and individualized approach to the selection of anesthetic management strategies [3, 6, 4].

In recent years, particular attention has been paid to the concept of balanced anesthesia, which is based on the combination of systemic and regional techniques. One of the promising and pathophysiologically justified methods is the use of the quadratus lumborum (QL) block, which can provide both significant antinociceptive protection and improvement in regional blood flow without a considerable impact on central hemodynamics [2, 5].

Aim of the work: To compare and evaluate the effects of two balanced anesthesia approaches on hemodynamics and peripheral circulation parameters in patients with chronic heart failure undergoing gynecological surgery**.**

Materials and Methods

This clinical study involved 52 female patients aged 50 to 65 years (mean age: 59.7 ± 3.6 years), treated between 2022 and 2024 in the Department of Gynecology at the Multidisciplinary Clinic of Tashkent Medical Academy. The patients underwent planned gynecological surgeries, including total and subtotal hysterectomies as well as reconstructive-plastic interventions. All patients with chronic heart failure underwent comprehensive preoperative evaluations. The degree of heart failure was determined by a cardiologist based on appropriate clinical and functional assessments.

The use of a functional nitroglycerin test allowed for a non-invasive and reliable evaluation of the cardiovascular system's reactivity to vasodilatory stress, facilitating the identification of prognostic parameters for hemodynamic instability. Two distinct types of hemodynamic responses were identified, reflecting varying levels of compensatory capacity of the cardiovascular system.

Group A (n = 22) included patients with reduced cardiovascular reserves who received general combined anesthesia (GCA) with mechanical ventilation and a quadratus lumborum (QL) block. Group B (n = 30), consisting of patients with positive adaptive-compensatory capabilities, received spinal anesthesia (SA) with low doses of hyperbaric bupivacaine (7.5 mg), in combination with a QL block (25 mL of 0.25% bupivacaine with 2 mg of dexamethasone on each side), while maintaining spontaneous breathing.

A comprehensive functional assessment of cardiovascular reserves was performed preoperatively and included the following:

- Sublingual nitroglycerin test (500 mcg), with recorded changes in cardiac index (CI), total peripheral vascular resistance (TPVR), systolic pressure gradient (SPG), and left ventricular myocardial mass index (LVMI);
- Six-minute walk test (6MWT);
- Calculation of the reserve coefficient (RC).

Intraoperative monitoring included:

- YM-300 (heart rate, systolic arterial pressure, TPVR, SpO_2, pO_2, pCO_2, skin temperature, BIS index),
- Impedance cardiography (CI, stroke index),
- Echocardiography (ejection fraction, end-diastolic volume, end-systolic volume).

Additionally, the temperature gradient (Δt°) between the earlobe and fingertip, as well as the minute urine output, were measured. Data were collected at six time points: 24 hours before surgery, upon entering the operating room, before incision, after incision, during the most traumatic moment, and at the end of surgery.

The purpose of using these methods was to comprehensively evaluate the impact of different anesthetic techniques on hemodynamic stability, stress response, and safety in patients with cardiovascular pathology undergoing gynecological surgery.

Results and Discussion: As shown in the table, the baseline hemodynamic status of patients in both study groups was characterized by signs of moderately expressed heart failure and a hypokinetic type of circulation. The total peripheral vascular resistance (TPVR) was elevated, and the cardiac index (CI) averaged 1.94 ± 0.09 L/min/m².

Notably, there was a moderate increase in the temperature gradient (Δt°) compared to expected physiological values, along with a decrease in hourly urine output (see Table 1), which indirectly indicates a moderate spasm of the peripheral vessels

Table 1. Selected indicators of hemodynamics and peripheral circulation at various stages of anesthesia and surgery in patients with heart failure from Group A and Group B

Parameter	Group	Preop.	Pre-incision	Post-incision	Peak surgical stress	End of surgery	Post-op
SPG (mmHg)	B	97.8 ± 3.4	100.4 ± 3.2	89.6 ± 2.1 *$p_1<0.05$; $p_2<0.001$*	92.9 ± 2.4	93.6 ± 2.2	92.4 ± 2.8
	A	98.6 ± 3.82	102.3 ± 2.8	105.9 ± 3.1 *$p_3<0.001$*	94.3 ± 1.6 *$p_2<0.05$*	94.8 ± 1.8	93.8 ± 1.8
Stroke Index (SI) (mL/m^2)	B	24.6 ± 1.8	23.6 ± 1.8	24.2 ± 1.6	23.9 ± 1.4	23.8 ± 1.6	25.2 ± 1.3
	A	24.5 ± 1.5	23.2 ± 1.2	23.4 ± 1.4	24.1 ± 1.1	23.9 ± 1.3	24.3 ± 1.1
Cardiac Index (CI) ($L/min/m^2$)	B	1.94 ± 0.09	1.94 ± 0.09	1.88 ± 0.11	1.89 ± 0.09	1.97 ± 0.11	1.98 ± 0.08
	A	1.89 ± 0.13	1.87 ± 0.11	1.92 ± 0.12	1.94 ± 0.11	1.94 ± 0.13	1.91 ± 0.09
TPVR ($dyn \cdot s \cdot cm^{-5}$)	B	2448.1 ± 72.5	2510.5 ± 89.4	2292.5 ± 64.2 *$p_2<0.05$*	2368.6 ± 90.6	2300.3 ± 88.4	2162.0 ± 72.4
	A	2528.3 ± 68.7	2658.4 ± 80.9	2678.3 ± 79.8 *$p_3<0.01$*	2318.4 ± 80.2 *$p_2<0.05$*	2352.4 ± 90.6	2324.3 ± 80.6
Δt (°C)	B	4.4 ± 0.32	5.9 ± 0.26 *$p_1<0.001$*	7.2 ± 0.36 *$p_1<0.001$; $p_2<0.01$*	5.8 ± 0.29 *$p_1<0.001$; $p_2<0.01$*	5.3 ± 0.36	4.9 ± 0.22
	A	4.8 ± 0.29	6.8 ± 0.34 *$p_1<0.001$; $p_3<0.05$*	6.9 ± 0.34 *$p_1<0.001$*	5.2 ± 0.28 *$p_2<0.001$*	5.4 ± 0.32	5.1 ± 0.26
Hourly Diuresis (mL/h)	B	0.92 ± 0.09	0.23 ± 0.02 *$p_1<0.001$*	0.42 ± 0.08 *$p_1<0.01$; $p_2<0.05$*	0.61 ± 0.09 *$p_1<0.05$*	0.60 ± 0.08 *$p_1<0.05$*	0.68 ± 0.07 *$p_1<0.05$*
	A	0.91 ± 0.08	0.19 ± 0.02 *$p_1<0.001$*	0.20 ± 0.02 *$p_{1,3}<0.001$*	0.39 ± 0.06 *$p_{1,2}<0.001$; $p_3<0.05$*	0.58 ± 0.06 *$p_{1,2}<0.05$*	0.64 ± 0.09 *$p_1<0.05$*

Abbreviations: SPG: Systolic pressure gradient; SI: Stroke Index; CI: Cardiac Index; TPVR: Total peripheral vascular resistance; Δt: Temperature gradient (earlobe–finger); p_1, p_2, p_3 – statistical significance between different stages or groups.

Following transportation to the operating room, patients in both study groups demonstrated an increase in heart rate (HR) by 5.6–4.9%, a rise in systolic pressure gradient (SPG) and total peripheral vascular resistance (TPVR), and a tendency toward decreased stroke volume (see Table 1). These changes were likely due to activation of the sympathoadrenal system. The temperature gradient (Δt°) in Group A increased by 34% ($p<0.001$), and in Group B by 41.7% ($p_1<0.001$; $p_3<0.05$). Against this background, minute diuresis in Group A was 0.23 ± 0.02 mL/min ($p_1<0.001$), and in Group B — 0.19 ± 0.02 mL/min ($p_1<0.001$; $p_3>0.05$), corresponding to pronounced oliguria.

Immediately prior to skin incision, during the “surgical stage” of anesthesia, patients in Group B showed a decrease in HR, SPG, and TPVR, which was interpreted as a classical manifestation of central neuroaxial blockade. Stroke and cardiac output did not change significantly. Notably, minute diuresis significantly increased to 0.42 ± 0.08 mL/min ($p_2<0.05$), likely due to the spread of sympathetic blockade to renal innervation and the associated vasodilation.

During the same period, patients in Group A, who underwent general combined anesthesia (GCA) with mechanical ventilation, exhibited an increase in HR, SPG, and TPVR. Stroke index

(SI) and cardiac index (CI) remained unchanged. The temperature gradient and minute diuresis also showed no significant changes compared to the previous stage, indicating persistent peripheral vasospasm. These findings, in contrast to the parameters observed in Group B, may be attributed to anesthesia-related stress caused by tracheal intubation and the brief hypoxia that often accompanies it, as well as an incompletely established QL block due to insufficient time for onset.

During the most traumatic phase of the surgery, both groups maintained hemodynamic stability without signs of peripheral vasospasm (see Table 1), indicating adequate antinociceptive protection against surgical stress in patients with heart failure. The evaluated hemodynamic parameters did not significantly differ from the baseline preoperative values or from those recorded in the previous stage. The temperature gradient showed a tendency to decrease. Urine output in Group A remained unchanged, while in Group B it increased to 0.58 ± 0.06 mL/min (p_2<0.05; p_3>0.05).

The end of the surgery was also characterized by hemodynamic stability, with no adverse changes in the indicators of peripheral circulation. No statistically significant differences were observed between Groups A and B at this stage. All parameters approached baseline preoperative values and did not significantly differ from them. The only exception was minute diuresis, which remained 26.1% and 28.6% lower than preoperative levels in Groups A and B, respectively (see Table 1). Nevertheless, overall renal perfusion and function were preserved.

Comparative analysis revealed that spinal anesthesia combined with a QL block provided more pronounced peripheral vasodilation, reduced vascular resistance, and increased diuresis compared to general anesthesia. At the same time, both anesthetic approaches maintained stable heart rate, SPG, and cardiac output values.

Conclusions

1. Both balanced anesthesia techniques incorporating quadratus lumborum (QL) block ensure stable systemic hemodynamic parameters at all stages of gynecological surgery in patients with chronic heart failure (CHF) of functional classes II–III.
2. Spinal anesthesia with QL block and preserved spontaneous breathing promotes more pronounced peripheral vasodilation, a significant reduction in total peripheral vascular resistance (TPVR), and an increase in minute diuresis, indicating improved regional blood flow and more effective renal perfusion.
3. Under general combined anesthesia with mechanical ventilation, a more pronounced sympathoadrenal response is observed in the early stages (elevated TPVR and reduced diuresis), which may be attributed to intubation-induced stress and the delayed onset of regional blockade.
4. The obtained data confirm the necessity of an individualized approach in selecting anesthetic management, with mandatory preoperative assessment of the cardiovascular system's functional state and adaptive reserve.
5. The QL block, as part of a balanced anesthesia strategy, is a pathophysiologically justified component that provides hemodynamic protection and ensures high clinical safety during surgical interventions in patients with CHF.

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