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CLINICAL REPORT

Effective control of paroxysmal tachycardia with landiolol hydrochloride during cesarean section in a patient with hypertrophic obstructive cardiomyopathy

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Abstract Hypertrophic obstructive cardiomyopathy (HOCM) involves marked hypertrophy of cardiac muscle, resulting in myocardial ischemia and arrhythmia because of left ventricular diastolic dysfunction. In perioperative management of HOCM, hemodynamic stabilization is required, by prevention of arrhythmia and tachycardia and maintenance of preload and afterload. Here, we describe anesthesia management during cesarean section in a patient complicated by HOCM. The patient was a 27-year-old woman who underwent elective cesarean section scheduled at 36 weeks of pregnancy given her history of HOCM. She was managed with spinal anesthesia with monitoring of invasive blood pressure and arterial pressure cardiac output. Administration of landiolol hydrochloride was initiated, because of paroxysmal tachycardia after delivery. Approximately 5 min after initiation of administration, her heart rate decreased gradually and blood pressure rose. Circulatory dynamics stabilized and landiolol was discontinued 3 h after she was admitted to the intensive care unit. Her circulatory dynamics remained stable after discontinuation of landiolol, and she was moved to a general ward on the following day. She was discharged on postoperative day 14, with her child.

Keywords Landiolol hydrochloride · Hypertrophic obstructive cardiomyopathy · Cesarean section · Spinal anesthesia

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Introduction

Landiolol hydrochloride is a selective β-blocker used for treatment of intraoperative tachyarrhythmia because it can rapidly reduce heart rate without a decrease in blood pressure. Here, we describe the successful use of landiolol for tachycardia during cesarean section in a patient complicated by hypertrophic obstructive cardiomyopathy (HOCM). Landiolol administration resulted in adequate and safe circulatory management.

Case report

The patient was a 27-year-old pregnant woman (height, 157 cm; weight, 64.5 kg; prepregnancy weight, 53 kg). The result of her electrocardiogram (ECG) was revealed to be abnormal when she was 15 years old. She was diagnosed as HOCM and underwent annual follow-up examinations with no subjective symptoms. Her family history and medical history were otherwise unremarkable. She visited a nearby maternity clinic to request delivery at her family home, but an ECG showed an abnormality, and the obstetrician referred her to the obstetrical and gynecologic department of our hospital.

The patient was scheduled to undergo elective cesarean section at week 36 of pregnancy. Because she experienced no limitations in daily life, her symptoms were classified as New York Heart Association class I. The result of her blood test was almost normal, except for a high brain natriuretic peptide level of 177.8 pg/ml (normal level $<$18.4 pg/ml). Chest X-ray showed a mildly enlarged cardiac shadow (cardiothoracic ratio 52%). On ECG with leads II, III, $_{a}V_{F}$, and $V_{3–6}$, negative T-waves were observed. Transthoracic echocardiography revealed a thick

Table 1 Intraoperative hemodynamics

	Before anesthesia	Start of surgery	Expulsion phase	20 min after expulsion	5 min after landiolol initiation	End of anesthesia
HR (beats/min)	85	82	95	127	92	90
ABP (mmHg)	122/67	130/70	132/65	90/45	120/60	120/60
APCO (l/min)/APCI (l/min/m^2)	4.7/2.8	5.7/3.5	6.1/3.7	4.4/2.8	4.6/2.9	5.7/3.5
SV (ml/beat)	53	70	63	35	50	65
Landiolol (mg/kg/min)	–	–	–	0.125	0.04	0.02

HR heart rate, *ABP* arterial blood pressure, *APCO* arterial pressure cardiac output, *APCI* arterial pressure cardiac index, *SV* stroke volume

interventricular septum of 30 mm, a left ventricular outflow pressure gradient of 19.2 mmHg, and mild mitral regurgitation and tricuspid insufficiency. Systolic function of the left ventricle was normal with its ejection fraction of 70.7%. In M mode, asymmetrical septal hypertrophy and systolic anterior motion (SAM) of the mitral valve were observed.

After the patient entered the operation room, an arterial catheter was inserted into the left radial artery in order to initiate direct measurement of arterial pressure and arterial pressure cardiac output (APCO) with a Flo-Trac® sensor. A 1000-ml colloid solution was infused to sustain a preload. An epidural catheter was then inserted via L1/2, and spinal anesthesia was administered via L3/4, using 2 ml 0.5% hyperbaric bupivacaine to provide a preoperative level of anesthesia below T4. To prevent a decrease in blood pressure after injection of the local anesthetic, 0.1 mg phenylephrine hydrochloride was injected twice (0.2 mg in total). After confirmation of stable circulation dynamics, surgery was initiated. Blood pressure and heart rate were 130/70 mmHg and 82 beats/min, respectively. The baby was delivered 6 min after initiation of the operation, and 1000 μg prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) was then injected into the myometrial muscle and 15 U oxytocin was administered by continuous IV injection, both as post-expulsive uterotonic agents.

Twenty minutes after expulsion, tachycardia developed with a decrease in blood pressure to 90/45 mmHg and an increase in heart rate to 127 beats/min. Spinal anesthesia was effective for pain relief, and the patient did not complain of pain. A drop in stroke volume (SV) was observed and acetate Ringer's solution was infused, but there was no improvement of the symptom. Therefore, landiolol hydrochloride was administered at a dose of 0.125 mg/kg/min for 1 min followed by continuous infusion at a reduced dose of 0.04 mg/kg/min. Heart rate gradually decreased 5 min after landiolol initiation, resulting in elevated blood pressure, APCO, and SV (Table 1). We gradually reduced the landiolol dose, and transferred the patient to the intensive care unit (ICU) for follow-up. Intraoperative infusion volume was 3500 ml, blood loss was 1240 g, including amniotic fluid, and urinary output was 190 ml.

After transfer to the ICU, we again reduced the dose of landiolol and discontinued landiolol 3 h after admission to the ICU. For postoperative analgesia, 0.2% ropivacaine was continuously infused into the epidural cavity at 5 ml per hour. After discontinuation of landiolol, circulatory dynamics remained stable, and on the following day the patient was transferred to the general ward. On postoperative day 14 both the patient and her baby were discharged from the hospital.

Discussion

The primary manifestations of HOCM are left ventricular diastolic dysfunction caused by stiffened left ventricular wall and blockage of the left ventricular outflow tract because of marked thickening of a portion of the cardiac muscle. Left ventricular diastolic dysfunction caused by the hypertrophic cardiac muscle reduces the duration of left ventricular inflow and elevates end-diastolic blood pressure in the left ventricle. This may then affect left ventricular filling and cause myocardial ischemia and various types of arrhythmias. To avoid these complications, preventing arrhythmias and tachycardia, and maintaining preload and afterload are required in perioperative management [1]. Because HOCM may cause sudden death, careful monitoring for arrhythmias and tachycardia or excessive variation in circulatory dynamics is required. Transesophageal echocardiography (TEE) is preferred for monitoring left ventricular function and a pulmonary artery catheter (PAC) is inserted to measure cardiac output, pulmonary artery wedge pressure, and central venous pressure [2].

In describing anesthetic management during cesarean section for a patient with HOCM, Kobori et al. reported perioperative considerations and concluded that special attention should be paid to the effect of anesthetic agents on the mother's uterine muscle and the fetus, the uterotonic administration procedure, reduced arterial pressure, and

cardiac output during expulsion, and the reduced circulating blood volume associated with sudden bleeding [2]. Kobori et al. colleagues treated the intraoperative paroxysmal tachycardia with continuous verapamil infusion and a single IV injection of propranolol. β-Blockers are generally regarded as reliable treatment for paroxysmal tachycardia with HOCM.

Landiolol hydrochloride has rapid efficacy against intraoperative tachyarrhythmia because it reduces the heart rate 2–3 min after administration with no drop in blood pressure. Moreover, landiolol has superior β_1 selectivity and adjustability compared with other β-blockers because of short half-life, which is assumed to be responsible for its efficacy in perioperative transient arrhythmias [3]. Several studies have described landiolol administration for HOCM and SAM of the mitral valve [4–6], and have reported that landiolol reduces heart rate and myocardial oxygen demand, and increases end-diastolic blood volume. Although any β-blockers can be used to control both the hyperdynamic myocardium and heart rate, overdosing may further reduce cardiac output and arterial blood pressure. Landiolol should be safer than other β-blockers, because of its adjustability, and SV measurements with the Flo-Trac® sensor are useful to monitor hemodynamic status in these circumstances. In addition, the monitor is less invasive than conventional TEE and PAC.

In our case, it was considered that hypovolemia or pain did not cause the paroxysmal tachycardia after expulsion because the preload was sustained by volume infusion, and spinal anesthesia effectively relieved pain. $PGF_{2\alpha}$ and oxytocin (both uterotonic agents) may induce tachycardia when administered after expulsion [7, 8]. Therefore, administration of these drugs may have resulted in paroxysmal tachycardia in our case. Indication of uterotonic agents should have been considered more carefully before surgery. In addition, landiolol can cause fetal bradycardia, resulting in catastrophic changes in the fetus. In this regard, even if landiolol administration is indicated during cesarean section, its use is limited to the postpartum period.

Local anesthesia (spinal or epidural) is recommended for cesarean section [9] and was selected instead of general anesthesia in our case on the basis of the patient's preferences. However, local anesthesia can cause large variability in blood pressure, because of reduction of afterload, and is designated as a relative contraindication in patients with HOCM [1]. Further studies are required to determine the most appropriate type of anesthesia in such cases.

In conclusion, our case suggests that tachycardia that develops during a cesarean section in patients with HOCM can be suppressed with landiolol hydrochloride, with maintenance of safe and stable circulatory dynamics based on APCO monitoring.

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