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CASE REPORT

Intermittent left bundle branch block following induction of general anesthesia in a healthy patient: a case report

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ABSTRACT

The occurrence of a new-onset left bundle branch block under anesthesia is a challenging event. Intermittent left bundle branch block is uncommonly encountered inside the operating room. However, proper recognition of the nature and pathogenesis of intermittent left bundle branch block can prevent undue cancellation of surgery without endangering patient safety. In this report, a 69-year-old previously healthy patient, scheduled for total knee replacement under general anesthesia, developed intermittent left bundle branch block shortly after induction of anesthesia. After a multidisciplinary assessment, the planned surgery was resumed and completed safely. The patient was successfully extubated and transferred to the recovery room. Our patient was strongly advised to proceed with a formal cardiac evaluation to exclude any cardiac pathology, especially coronary artery disease. In addition to this specific case, this report explores the clinical implications of intraoperative intermittent left bundle branch block and its perioperative management plans.

KEYWORDS

Transient; intermittent; left bundle branch block; rate-dependent.

INTRODUCTION

A new-onset left bundle branch block (LBBB) under anesthesia is a challenging event for both the anesthetist and the surgeon[(1)]. A new-onset LBBB is usually secondary to coronary artery disease, hypertension, cardiomyopathy, or degenerative heart disease. However, intermittent LBBB, indicating the presence of both normal and aberrant conduction in the same electrocardiogram (ECG) tracing, has been reported with breath holding, straining, and acute heart rate changes. Differentiating the specific conditions that precipitated the onset of LBBB guides perioperative decision-making[(2-4)]. The presence of hemodynamic affection and the appearance of end-organ damage may trigger the team to end the procedure for further evaluation. On the other hand, the nature of the procedure and the stage the surgery has reached at the time of the event may require the continuation of the procedure.

CASE REPORT

The research ethics committee approved this case report with a waiver of the patient's consent (IRB approval No. ECC#2024-03). A 69-year-old male patient with no past medical history was scheduled for total knee replacement under

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general anesthesia. Preoperative ECG revealed normal sinus rhythm with non-specific findings (Figure 1A). The preoperative echocardiography showed good systolic function (EF 55%), no resting wall motion abnormalities, and no valvular lesions. After attaching the patient to basic monitors and securing IV access, anesthesia was induced using IV fentanyl citrate (1 μg/kg), IV propofol (2 mg/kg), and IV atracurium besylate (0.5 mg/kg). The initial ECG trace showed sinus rhythm. A few minutes later, the ECG trace changed to a wide complex pattern mimicking LBBB (wide complex, dominant S wave, discordant ST segment and T wave) with a P wave preceding each QRS complex (excluding ventricular pacing) (Figure 1B). The patient was hemodynamically stable, and oxygenation was maintained, excluding blood pressure fluctuations and hypoxia as possible etiologies. Furthermore, no tachycardia, hypertension, sweating, or other signs of inadequate anesthesia were detected. The ECG trace alternated between narrow and wide complex rhythms (Figure 1C). An urgent cardiac consultation was requested. After reviewing the patient file, preoperative data, intraoperative ECG evaluation, and intraoperative echocardiography (eyeballing), the decision was to proceed to surgery. At the end of surgery, the patient was successfully extubated and transferred to the recovery room. Postoperatively, the patient did not report any cardiac symptoms and refused the treating team's advice to undergo a diagnostic coronary angiogram or any other investigations.

DISCUSSION

This report discusses the occurrence of intermittent LBBB in a previously healthy patient following induction of general anesthesia, a rare event that poses diagnostic and therapeutic challenges. A newly developed LBBB is mostly attributed to an acute myocardial ischemic event. However, other causes of LBBB must be explored, including stress response, the effect of anesthetic medications on cardiac impulse conduction, extreme fluctuations in blood pressure, and acute heart rate changes. Additionally, the administration of some non-anesthetic medications can be implicated in the occurrence of LBBB: flecainide, antineoplastic medications, chloroquine, digitalis, azithromycin, phenothiazines, and tricyclic antidepressants[1]. Paradoxically, the reversal of LBBB to normal conduction can occur after exposure to general anesthesia due to the coronary dilator effect of inhalational agents plus the negative chronotropic effect of the anesthetic agents[5-7].

In our case, the provisional diagnosis was rate-related LBBB, which is related to acute changes in the patient's heart rate, with a subsequent change in electrical impulse conduction. Rate-related intermittent LBBB is classified as either a tachycardia-dependent or a bradycardia-dependent block[8]. In the tachycardia-dependent block, the cardiac impulse arrives while the cardiac tissue is in Phase 3 of the action potential. In this phase, the myocardium is refractory to depolarization, resulting in an intraventricular conduction delay (Phase 3 block). Preferential LBBB occurs because the refractory period of the left bundle is longer than that of the right side, allowing the cardiac impulse to reach the left bundle while still partially repolarized[9,10]. Meanwhile, in a deceleration-dependent block, the longer diastole allows for spontaneous depolarization in the Purkinje cells, which subsequently increases the resting membrane

Figure 1. A – Baseline ECG tracing showing normal sinus rhythm; **B** – intraoperative ECG tracing showing wide complex mimicking LBBB; **C** – intraoperative ECG tracing alternating between normal rhythm and intraventricular conduction delay.

potential and closes part of the Na channels. This results in aberrancy of cardiac impulse conduction (pause-dependent or Phase 4 block) (see Figure 2)[9-11].

In our case, the use of opioids plus an inhalational anesthetic (sevoflurane) could be the cause of the deceleration-dependent intraventricular delay. Upon detection of the event, an urgent cardiac assessment was requested to exclude any major cardiac event. The intraoperative ECG showed the intermittent nature of the BBB and persistent sinus rhythm. The intraoperative echocardiography also revealed preserved preoperative readings with no wall motion abnormality or signs of myocardial ischemia. A multidisciplinary discussion, including the anesthetist, the orthopedic surgeon, and the cardiologist, explored the available options, including awakening the patient for further investigations or continuation to surgery. Based on the absence of preoperative medical illnesses or cardiac problems, the intraoperative hemodynamic stability, and the cardiologist's advice, there was an agreement to proceed to surgery. Afterward, the surgery resumed with no other events. The attending anesthetist decided not to use any pharmacological agents in this case, especially in the absence of any hemodynamic derangement.

Prompt identification of the etiology of LBBB is a critical determinant of the management strategy. The decision to continue or end the surgery must be guided by a multidisciplinary discussion among the anesthesiologist, the surgeon, and the cardiologist and must involve the patient's family. It is mandatory to thoroughly review patient history, investigations, baseline ECG, and echocardiography, if available. The evaluation must involve the extent of current hemodynamic impairment, if present, the nature of the planned surgery, and the stage of surgery in which the event started. A comprehensive cardiac assessment would start with a 12-lead ECG to identify any ischemic events and document the findings[12]. However, the diagnosis of ACS is challenging in the presence of LBBB electrical criteria (wide QRS complex with discordant ST segment). In this situation, concordant ST segment deviation, excessive discordance, or even dynamic ST changes can reflect ongoing myocardial ischemia (the Smith-modified Sgarbossa criteria)[13]. Intraoperative echocardiography can diagnose early signs of myocardial ischemia and exclude other major events like pulmonary embolism or stress-induced cardiomyopathy. Also, additional laboratory tests for electrolyte and cardiac enzyme levels would help with differential diagnosis and could provide a baseline for further follow-up[14].

The intraoperative management of rate-dependent LBBB targets the elimination of the precipitating factor. In a deceleration-dependent block, the anesthetist must avoid drugs that slow the heart rate, like beta blockers, alpha-2 blockers, or high-dose opioids. Special attention should be given to vagal maneuvers, such as rapid peritoneal insufflation, mesenteric traction, carotid sinus stimulation,

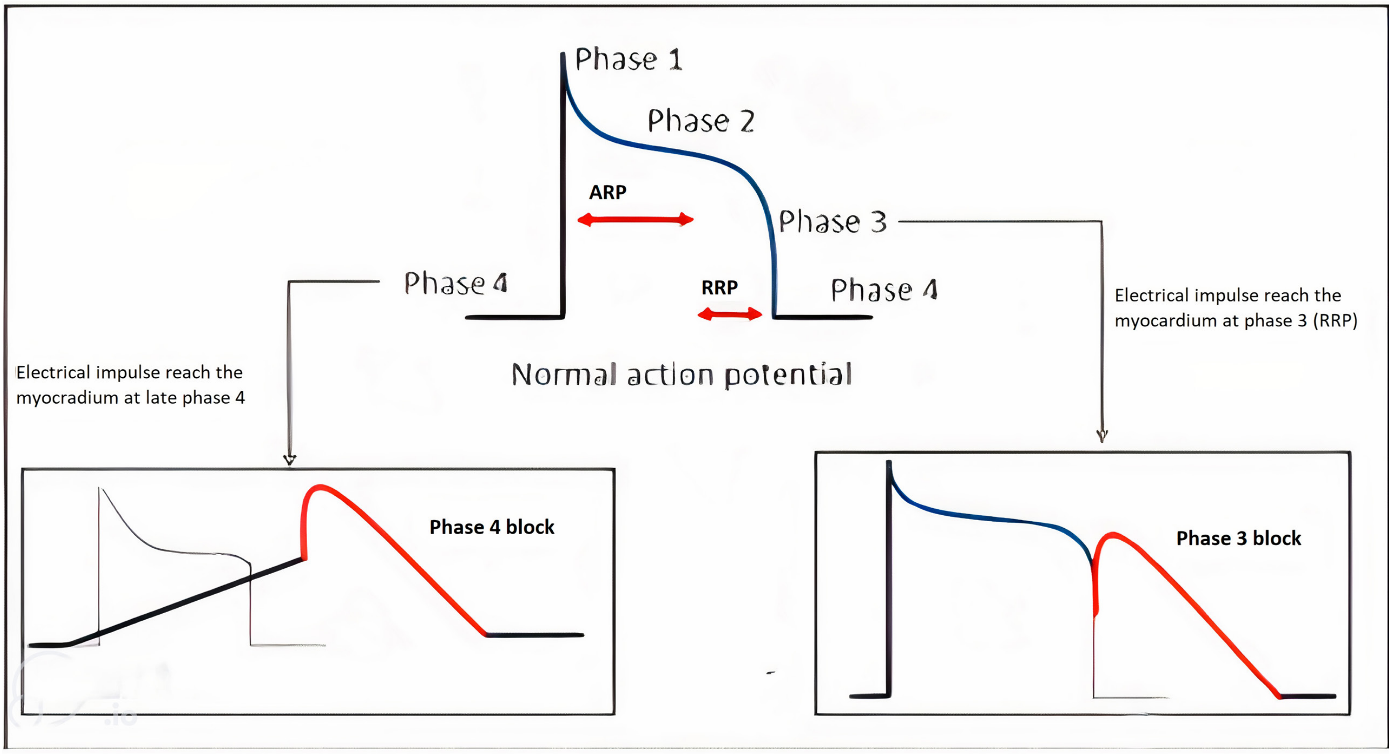

Figure 2. Pathogenesis of rate-dependent intermittent BBB. Top: Normal action potential. Lower right: Phase 4 block. Lower left: Phase 3 block. The dashed line indicates the normal conduction wave. The red line indicates the shape of the action potential after aberrant conduction.

and other procedures that can affect intracardiac conduction, including the insertion of a pacemaker and a pulmonary artery catheter. The use of anticholinergic drugs like atropine sulfate and glycopyrrolate to increase the heart rate and abort the implicated pathophysiological process should be weighed against the possible side effects[5-7]. In contrast, tachycardia-dependent LBBB is triggered by events causing tachycardia, like inadequate analgesia, sympathetic stimulation, the use of sympathomimetics, or vagolytic drugs. Contrarily, adequate depth of anesthesia, adequate analgesia, and negative chronotropic drugs can be protective[2].

The literature includes many reports of intermittent LBBB after induction of anesthesia[3-6]. As in our case, most of the reported cases completed the planned surgery, and patient outcome was favorable, with no related complications. In a meta-summary including 24 reported cases of transient BBB under anesthesia, the planned surgery was completed, and the patient was discharged from the hospital without complications[2]. Surprisingly, most patients did not accept recommendations for further cardiac assessment to exclude coronary artery disease; this may have been for cultural or economic reasons[2].

We recommend that, regardless of the decision to continue or cancel the planned surgery, all patients should undergo further cardiological assessment in the postoperative period. Patients should be admitted to a high dependency unit with continuous monitoring. Serial cardiac troponin levels may be measured if myocardial injury is suspected, as recommended by AHA guidelines[15]. Transthoracic or transesophageal echocardiography will assess systolic and diastolic functions and exclude valvular lesions. Stress ECG, stress echocardiography, CT coronary angiography, and nuclear myocardial scans can be used to screen patients before proceeding to the more invasive coronary angiography[15].

In conclusion, new-onset intermittent LBBB revealed after induction of general anesthesia is a rare but significant event that deserves thorough evaluation before deciding to proceed or cancel the surgery. Although the planned procedure can be completed safely in most cases, further cardiac evaluation is paramount to exclude coronary artery disease or other cardiac pathologies.

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