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Short communications

Application of prophylactic gel-pads for transcutaneous pacing in patients with complete right bundle-branch block with axis deviation when surgical procedures are performed: 10-year experience from a single Japanese university hospital

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Abstract
This retrospective study aimed to determine whether prophylactic transcutaneous pacing is required for patients with complete right bundle-branch block (CRBBB) and axis deviation (AD), so-called bifascicular block, when surgical procedures are performed under general or local anesthesia. The authors reviewed 34063 anesthesia cases that took place at Nara Medical University Hospital during a 10-year period (1996–2005). The anesthesia records of all identified patients having CRBBB or bifascicular block were retrospectively reviewed and the incidence of block progression to complete heart block or bradycardia requiring temporary transcutaneous pacing served as the primary endpoint. As a secondary endpoint, the incidence of block progression to complete heart block or bradycardia requiring only medical treatment was checked. Seventy of the 34063 patients (0.2%) had CRBBB with AD. Only 1 patient with CRBBB with left AD, who underwent on-pump aorto-coronary bypass grafting surgery, developed complete heart block at the resumption of heartbeat. None of the other 69 patients, except for this cardiac case, developed complete heart block during surgery. Based on this analysis of 70 cases, prophylactic gel-pad electrode application in patients with CRBBB and AD does not appear to be necessary during surgical procedures.

Key words Complete right bundle-branch block · Axis deviation · Complete heart block · Transcutaneous pacing

The combination of complete right bundle-branch block (CRBBB) and abnormal left or right axis deviation (LAD or RAD) represents right bundle-branch block with block of the anterior or posterior division of left bundle-branch, so-called bifascicular block [1]. There are clinical considerations as to whether the stress of anesthesia and surgery might predispose patients with this block pattern to advanced complete heart block. Previous studies as early as the 1970s questioned the need for prophylactic pacemaker implantation before surgery in this patient population [2,3]. It was concluded that the routine placement of temporary pacemakers was not necessary for such patients. In the 1970s, temporary pacemaker placement definitely required invasive procedures for the insertion of pacing electrodes. Alternatively, however, since the 1980s transcutaneous pacing has been available. The application of gel-pad electrodes for transcutaneous pacing does not require any invasive procedures. Since the advent of transcutaneous cardiac pacing, we have used gel-pad electrodes for all patients with bifascicular block who require surgery, just prior to anesthetic induction. However, the routine use of gel-pad electrodes, even though it is risk-free, does produce a higher cost. Therefore, it is natural to think that the decision on the application of prophylactic gel-pad electrodes for such patients should be re-evaluated on a cost-effectiveness basis. This study was conducted to determine whether prophylactic application of gel pads is necessary in patients with CRBBB and axis deviation (AD).

Institutional review board approval and informed consent were not required because there were no ethical problems with this study. During a 10-year period (1996–2005) we had 34063 anesthesia cases at Nara Medical University Hospital. All patients undergoing surgery had had 12-lead electrocardiograms, which were available retrospectively for evaluation, taken as part of their preoperative investigation. In order to identify the patients who had CRBBB, the following criteria were used: CRBBB was defined in those patients in whom the QRS duration was more than 0.12 s with an rsR' pattern or RsR' pattern in the right precordial leads (V1) and S waves in V5, V6. In these patients, the presence of bifascicular block was determined by the simultaneous presence of AD (left or right), pointing to anterior or posterior left hemiblock. Left AD (LAD) was defined as axis ranging from -30° to -90° and absence

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of standard criteria of inferior myocardial infarction. Right AD (RAD) was defined as axis more than 100° [4].

All patients had continuous ECG monitoring while they were in the operating theater. In all patients identified to have bifascicular block, gel-pad electrodes for transcutaneous cardiac pacing were applied, based on the institutional anesthesia management protocol. After connecting the electrodes to a pacemaker generator, the pacemaker generator was switched to the standby mode with the initial settings (impulse duration, 40 ms; frequency, 50 beats· min^{-1} (bpm), and intensity, 50 mA). Prior to anesthetic induction, the effectiveness of the pacemaker settings was not always checked, because electrical stimulation would have been painful for the awake patients. Anesthetic management was determined according to the attending anesthesiologist's preference. Hemodynamic status was basically managed according to the institutional protocol. When bradycardia of less than 45 bpm, regardless of conduction interval, or hypotension (drop in systolic blood pressure to less than 90 mmHg) was observed, atropine or ephedrine was administered for the first-line treatment. If refractory bradycardia or block progression was still observed, pacemaker stimulation was initiated depending on the situation.

We retrospectively reviewed the anesthesia records of all patients identified as having CRBBB or bifascicular block and we checked the incidence of block progression to complete heart block or bradycardia requiring temporary transcutaneous pacing as the primary endpoint. As a secondary endpoint, the incidence of block progression to complete heart block or bradycardia requiring only medical treatment was checked.

Of the 34063 anesthesia cases during the decade 1996–2005, 279 patients (0.8%) were identified to have CRBBB. Co-existing LAD was observed in 50 of these patients and right (RAD) was observed in 20 patients. There was a predominance of male over female patients in our study. Most patients were middle-aged to older adults, but the series encompassed children as young as 11 years and adults as old as 89 years. General anesthesia was performed in 255 patients, and regional anesthesia (spinal anesthesia and epidural anesthesia) was performed in 24.

A summary of preoperative coexisting diseases is shown in Table 1. Approximately, one-quarter to one-third of patients had cardiovascular diseases such as hypertension and coronary artery disease. However, none had any episodes of syncope or dizziness.

Only one patient with CRBBB with LAD, who underwent on-pump aorto-coronary bypass grafting surgery, developed complete heart block at the resumption of heartbeat. Occasionally, premature ventricular contraction, atrial fibrillation, and paroxysmal atrial tachycardia were observed in CRBBB patients regardless of co-existing AD. However, none of the CRBBB patients, except for this cardiac case, developed complete heart block during surgery.

There were no CRBBB patients who developed severe bradycardia (heart rate; HR < 40 bpm) with hemodynamic instability, regardless of co-existing AD. Ephedrine was always used, especially after anesthetic induction. Atropine was routinely co-administered with anesthetic induction agents. During the follow-up period (1–5 years) after discharge from the hospital, we confirmed that 3 of the 64 patients whom we could follow up developed complete heart block..

The application of a set of gel-pad electrodes to each patient had a cost of approximately $50. During the study period, the total cost for disposable gel-pad electrodes was $3500.

According to the results of this retrospective study, it was found that the incidence of bradycardia with hemodynamic instability was not high in patients with CRBBB and AD and none of the patients required temporary pacing support during surgery. Consequently, we have demonstrated that routine prophylactic gel-pad electrode application in patients with CRBBB and AD is not necessary. However, it has been difficult to determine the impact of prophylactic temporary pacemaker

Table 1. Preoperative co-existing diseases

	CRBBB + NAD (n = 209)	CRBBB + LAD (n = 50)	CRBBB + RAD (n = 20)	All patients (n = 279)
Hypertension	52	17	5	74
Coronary artery disease	6	5	1	12
Valve disease	9	4	0	13
Atrial fibrillation	5	4	0	9
AV block	1	1	0	2
Chronic obstructive pulmonary disease	18	3	0	21
Asthma	1	2	0	3
Diabetes mellitus	14	5	0	19

AV, atrioventricular; CRBBB, complete right bundle-branch block; LAD, left axis deviation; RAD, right axis deviation; NAD, no axis deviation

Table 2. Summary of previous reports regarding anesthetic management for patients with bifascicular block or LBBB

Authors	Number of patients	Type of block	Type of prophylactic pacemaker	Number of patients developing block progression
Pastore et al. [2]	44	CRBBB + LAD	Transvenous ($n = 6$)	0
Roony et al. [3]	27	CRBBB + LAD	None	0
Gauss et al. [7]	103	CRBBB + LAD or CRBBB + RAD or LBBB	None	1[a]
Gauss et al. [8]	39	CRBBB + LAD or CRBBB + RAD or LBBB	Transcutaneous ($n = 39$)	0

[a]This event was due to perioperative myocardial infarction, and not to block progression of the remaining branch

preparation on surgical patients with bifascicular block because the percentage of these patients among all surgical patients is very low (less than 1%) [2,3]. In addition, the incidence of perioperative progression to complete heart block in this population is extremely rare. Therefore, it is necessary to accumulate series in which prophylactic pacemaker placement for this type of patient group is evaluated in different study populations. In accordance with previous studies, our results reconfirm that routine prophylactic placement of temporary pacemakers in such patients should be questioned.

It has been reported that the prevalence of bundle branch block is 1% at age 50 years and its incidence increases with aging [5,6]. Lasser and colleagues [5] reported that 59% of patients with symptomatic advanced or complete heart block showed an electrocardiographic pattern of CRBBB and marked LAD. Moreover, they also noted that 10% of patients who acquired RBBB with a marked LAD pattern eventually developed complete heart block and Adams-Stokes syndrome [5]. In addition, Scanlon and colleagues [1] reported that 20 out of 147 patients (13.6%) who had both LAD and CRBBB eventually developed complete heart block during a 2-year observation period. Collectively, a history of syncope or transient dizziness in a patient with this bifascicular pattern may denote that episodes of heart block have occurred. Therefore, it is natural to think that the stress of anesthesia and surgery might predispose patients with this block pattern to advanced complete heart block in the perioperative period.

Several studies have been undertaken to determine the need for prophylactic temporary pacemaker lead insertion for surgical patients who had the electrocardiographic abnormality of CRBBB with AD prior to surgery (Table 2). Pastore and colleagues [2] investigated the risk of advanced atrioventricular block during anesthesia in 44 patients with RBBB and LAD. Temporary pacemakers were implanted in 6 of these patients who had a prolonged PR interval or who developed transient complete heart block by carotid sinus massage. They found that none of the 6 patients developed complete heart block because of block progression to the remaining fascicle. In addition, Gauss and colleagues [7] assessed the rate of perioperative block progression and bradyarrhythmia in 103 surgical patients who had bifascicular block or LBBB. They observed that 8 patients developed severe bradyarrhythmia with hypotension; however, these patients recovered with pharmacotherapy only. They also observed 1 patient who developed block progression to second-degree atrioventricular block and consecutive cardiac arrest; however, this event was due to perioperative myocardial infarction [7]. In other studies, none of the investigators reported perioperative block progression in surgical patients with bifascicular block [3,8]. From these results, it is reasonable to conclude that temporary pacemaker insertion, which needs invasive procedures, is rarely required in asymptomatic patients with bifascicular block.

In conclusion, intraoperative severe bradycardia with hemodynamic instability was not observed in a series of 70 patients with bifascicular block during the past decade, and no patients required temporary pacing support during surgery, although prophylactic gel-pad electrodes for temporary pacing were applied for all the patients. Our findings are based on observations of patients with asymptomatic bifascicular block. Therefore, we can conclude that routine prophylactic gel-pad electrode application is not necessary in patients with asymptomatic bifascicular block.

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