A Simple Catheter Technique for Production of AV Block

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Aizawa, Y., Tamura, Y., Murata, M., Satoh, M., Aizawa, M., Shibata, A. and Maruyama, N. A Simple Catheter Technique for Production of AV Block. Tohoku J. exp. Med., 1985, 147 (2), 177-181 —— Atrioventricular (AV) block was produced in animals for experimental purposes by use of a newly devised cannula. It has bipolar electrodes; one electrode on the needle tip and the other 5.0 mm proximally from the tip. Otherwise, the cannula was electrically completely insulated. The cannula was inserted from the right external jugular vein and advanced close to the AV ring. While His bundle electrogram was obtained with the electrodes, the AV node was accessed. The injection site was determined as the point where His bundle electrogram can be well recorded and the atrial electrogram is close to or larger than the ventricular electrogram in amplitude. Xylocain solution, 0.2 to 0.4 ml, was injected with the syringe attached on the other end of the cannula. Transient AV block occurred when the needle tip was properly positioned. Then, 0.2 ml to 0.4 ml of anhydrous alcohol was added to make permanent a AV block. A possible application of this technique was implicated. ——— catheter technique; AV block; His bundle ablation; sclerosing material

Atrio-ventricular (AV) block has been produced to control tachycardia in man for therapeutic purpose and in animals for experiments (Ginnelli et al. 1967; Robinson et al. 1973; Klein et al. 1980; Beazell et al. 1982; Aizawa et al. 1985). Electrical ablation of the His bundle has been successfully performed for intractable supraventricular tachycardia (Gallagher et al. 1982; Nathan et al. 1984), and even the ablation of the concealed Kent bundle has been tried (Fisher et al. 1984). This procedure requires, however, general anesthesia and major complications though infrequent were reported. Another method involving an injection of sclerosing materials into the AV nodal region has been tried in open-chest (Steiner and Kovalik 1968) or in closed-chest dogs using a special cannula under a fluoroscopic guide (Babotai and Brownlee 1971). His bundle electrogram was used to determine the injection site of sclerosing materials but this method has not
been developed further (Williams et al. 1969). A new catheter is devised which can record His bundle electrograms through bipolar electrodes, and through which sclerosing materials can be injected. This paper describes this simple catheter technique and discusses its possible application in humans.

**Material and Methods**

The cannula

The cannula consisted of four components; bipolar electrodes, a needle to inject a sclerosing material, a handle to manipulate the needle, and a syringe (Fig. 1). The cannula was completely insulated except for the tip (the needle) and the electrode attached 5 mm proximally from the cannula tip. The electrodes were connected to a DC amplifier, and His bundle electrograms were obtained in a routine manner. From the distal end, the small stainless needle (24 or 25 gauge) can be advanced to puncture the endocardium. The needle can be moved back and forth and the distance can be adjusted at the handle. The cannula has a smooth curve toward the tip. A 1 ml syringe is connected for the injection of sclerosing materials.

![Fig 1. The schematic representation of the newly devised catheter. From the tip, a needle which serves as an electrode can be advanced into subendocardial tissue. To avoid injury, the end has a round head. Another electrode is attached 5 mm from the tip, and with this and the needle electrode, His bundle electrogram can be recorded as shown in Fig. 2. On the other end, a syringe is attached which is connected to the tip needle. It has two screws, one for the adjustment of the distance to advance the needle (screw 1), and the other to anchor the needle during the injection of sclerosing material (screw 2).](image)

The determination of the injection site

The cannula was advanced from the right external jugular vein into the right atrium and close to the AV ring. A site was sought where a good His bundle electrogram could be recorded. In this position, the amplitude of atrial electrogram should be large enough, usually exceeding the amplitude of the ventricular electrogram. When the cannula was pushed, the atrial electrogram was distorted into a monophasic curve which indicates that the tip was certainly above the AV ring. This finding is important to avoid the injection of the sclerosing material into the ventricular free wall or the accidental production of bundle branch block.

Injection of sclerosing materials

After the determination of the injection site as mentioned above, 0.2 ml of 2% lidocaine hydrochloride (Xylocain) mixed with a contrast material (Urografin) was injected subendocardially which should result immediately in AV block. The injection site could be confirmed by fluoroscopy. Then, 0.2 to 0.4 ml of anhydrous alcohol was added. Fifteen minutes were allowed to elapse to see if AV conduction recovered. The dogs were then paced electrically at the right ventricle and kept for several weeks until another experiment was performed. The gross appearance of the heart around the AV node was examined after sacrifice.
RESULTS

Catheter introduction and His bundle electrogram recording

The catheter could be introduced into the right atrium through the right external jugular vein in 10 dogs weighing 6.0 to 12.0 kg. Good recording of His bundle electrogram was obtained in 6 dogs as shown in Fig. 2. Atrial electrograms were equal to or exceeded ventricular ones in amplitude. Pushing the catheter in this position, the atrial electrogram was distorted into a monophasic action potential-like configuration.

![Lead II ECG (upper) and His bundle electrograms (lower) obtained from a dog with the catheter. Large atrial potentials and His spikes are evident. The original record was detached.](image)

Injection of sclerosing materials and production of AV block

This procedure was performed in 6 dogs in which a good recording of His bundle electrogram was obtained. Immediately following the injection of 0.2 ml of Xylocain, AV block occurred. Then, 0.2 to 0.4 ml of anhydrous alcohol was additionally injected. Slow rhythm originating below the His bundle developed in about 30 sec and then became regular. The ventricle was paced by the catheter repositioned in the right ventricle. A transient complete AV block was produced in each dog. It was usually necessary to wait for 15 min to see if AV conduction recovered. If AV block lasted for 15 min or longer, it could be considered that the AV block was irreversible. Then a transvenous pacing lead was implanted so that the tip was placed at the right ventricular apex and the animals were paced at 90 beats/min. Three weeks later, other experiments were conducted and the heart was excised after the experiment. The gross appearance of the heart showed no change except for a slightly white patch in the AV nodal area. No damage to the tricuspid leaflet was observed in 6 dogs. Fig. 3 shows AV block in one dog at the third week after the procedure. AV dissociation was apparent when the right
ventricular pacing was stopped. If a good His bundle electrogram was obtained and the site for injection of sclerosing material was accessed, AV block was made in 83% (5/6). One dog with recovery of AV conduction showed a prolonged PR interval and split His spikes.

**DISCUSSION**

Catheter-induced ablation of the His bundle has been used in the treatment of supraventricular tachycardia (Gallagher et al. 1982; Nathan et al. 1984; Fisher et al. 1984). To allocate the AV node, His bundle electrograms have been used, and at the position where the amplitude of atrial electrograms are large enough, direct electric current has been applied through the catheter and a paddle positioned in the back. However, this technique has needed general anesthesia since 200 joules/sec or larger energy has to be applied. We have applied this method to a case with 1:1 conduction of atrial tachycardia (220–230 beats/min) (Satoh et al. 1984). Because of the rapid ventricular response, the general condition was very poor and assistance of respiration and administration of pressor drugs was required. Antiarrhythmic drugs failed to control the ventricular rate. In such patients, the induction of general anesthesia may be not free of complication. Rupture of the tricuspid leaflet is a potential complication though infrequent (Beazell et al.1982).

Injection of sclerosing materials into the AV nodal region in open-chest dogs is a simple method with a high success rate (Steiner and Kovalik 1968) and applicable to experiments in dogs (Aizawa et al. 1985). In closed-chest dogs, a catheter was introduced and injection of sclerosing materials has been tried under a fluoroscopic guide and recording of His bundle electrogram (Babotai and Brownlee 1971; Williams et al. 1969). The intracardiac potential recorded by a unipolar lead through the catheter was not good. To record the His bundle electrogram clearly, a new catheter is developed which can record His bundle electrogram through bipolar electrodes and through which sclerosing materials can be injected into the subendocardium of the AV nodal region. This technique needs only local anesthesia if it is applied to man. Forty percent formalin was the sclerosing material used for the production of AV block (Steiner and Kovalik, 1968; Williams et al. 1969; Babotai and Brownlee 1971), but it can not be used
in man, and anhydrous alcohol is employed in the present study to see if it can produce permanent AV block (Murata et al. 1984). Any leak of alcohol into the cardiac cavity will be harmless. Furthermore, the right sided accessory pathway in WPW syndrome may be determined by this catheter and it may be possible to ablate Kent bundle by the present technique. The reason of inability to make AV block in some dogs is due to a failure to access His bundle because of a difficulty in manipulating the catheter in small dogs. If a cannula of proper size and curvature is applied, AV node will be accessed and the method will be applicable to humans.

References