論　文　要　旨
Thesis Abstract

(yyyy/mm/dd)　2021 年 6 月　24 日

※報告番号	甲第３００号	氏　名 (Name)	KRIENGSAK MASNOK

主論文題名　（Title）

Investigation of catheter's contact force and angle effects on contact area and lesion size in radiofrequency catheter cardiac ablation

（高周波カテーテル式カーディアックアブレーション術における
カテーテルの接触力と角度が接触面積および焼灼領域に与える影響の検証）

内容の要旨　（Abstract）

Over the past three decades, radiofrequency (RF) catheter ablation therapy has become a widely used and effective treatment for some cardiac arrhythmias. Catheter contact force and contact angle are well known as the factors that influence the size of the lesion produced during ablation. However, it was unknown exactly in detail how these factors influence each ablation dimension. Moreover, the relationships between various parameters and lesion dimensions are still indefinite, especially the relationship between contact area and lesion area as the function of catheter contact force and angle. Accordingly, this research aimed to investigate the effects of catheter contact force and contact angle on contact area and lesion size in radiofrequency catheter cardiac ablation. The work presented in this thesis was divided into two main parts;

The first part focused on investigates the effects of catheter contact force and contact angle on the catheter contact area. The main objectives of this part were to develop an experimental procedure for setting the catheter angle with respect to the surface of the heart muscle and the catheter contact force, as well as to investigate the catheter contact area on the heart muscle as a function of catheter contact angle and contact force. This present study successfully developed the experimental system that enables us to set the precision catheter contact angle with respect to the heart muscle's surface and the catheter contact force. This study showed that the present experimental system has feasibility for use to study radiofrequency catheter ablation. The findings can be summarized as follows; First, the morphology of the contact area can be divided into four types: rectangular, circular, ellipsoidal, and semi-ellipsoidal. Second, the morphology of the contact area indicates that the correlation between contact force and the contact area is a logarithmic function; that is, increased contact force was associated with increased contact area, and the contact angle has as strong an effect on the contact area as contact force does. Last, there is an inverse correlation between contact angle and contact area; a smaller contact angle is associated with increased contact area.

The second part of this thesis deals with the challenges to investigating the effects of catheter contact force and contact angle on the ablation lesion dimensions and investigating the effect of catheter contact force and contact angle on the ablation lesion dimension and the ablation impedance. In addition, this part also aims to investigate the relationship between the catheter contact area and the dimensions of the ablation lesion as a function of catheter contact angle and force in the radiofrequency catheter ablation process. This study showed an important role of the catheter contact force on the ablation lesion and impedance in RF catheter ablation procedures. The results showed that the catheter contact force has a significant correlation with ablation impedance, but the ablation impedance did not significantly differ with each catheter contact angle. In addition, the results revealed that the catheter contact area showed a strong correlation with the ablation lesion area. When the contact area was increased, the lesion area also increased linearly in a monotonic manner. The relationships between catheter contact force and ablation lesion area and between catheter contact force and ablation lesion depth are logarithmic functions in which increased contact force was associated with increased lesion area and depth. Lastly, the catheter contact angle is also an important determinant of the lesion area. The lesion area progressively increased when the contact angle was decreased. In contrast, the lesion depth progressively increased when the contact angle was increased.

Such information should be helpful in the selection of effective values for contact force and contact angle in order to predict lesion size as well as for clinicians performing this procedure to understand the relationships among the parameters and plan their ablation strategy accordingly.

※official use only