MANUAL SEGMENTATION IN ECHOCARDIOGRAPHIC IMAGING OF AORTIC STENOSIS

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Abstract: *Automation for the analysis of medical images requires correct interpretation and this has been a problem of interest in the area of cardiology. Segmentation in cardiac images is the fundamental part for the specialist to acquire anatomical and physiological measures of interest of the structure of the heart. This paper presents a set of manual segmentation techniques areas of anatomical and physiological interest in echocardiographic images of aortic stenosis, comparing different techniques to conclude with the advantages and disadvantages of manual segmentation.*

Keywords: *Segmentation, Aortic Stenosis, Image processing.*

1 INTRODUCTION

Cardiovascular diseases are the leading cause of mortality worldwide and there are probabilistic studies that in the next ten years the mortality rate will double worldwide (Who int., 2021). Aortic stenosis is one of the main heart diseases that is registered mainly in elderly patients since it is a disease with a slow development and is characterized by the thickening and calcification of the aorta valve (Venegas, 2015).

One of the devices of interest in clinical practice is the echocardiogram since it is non-invasive for the patient and is able to show real-time images of the physiology and anatomy of the heart (García et al., 2004). Therefore, the correct interpretation of medical images is essential to give a good diagnosis and treatment to the patient, however, problems arise such as blurred images or deficient to be interpreted (Erdmenger and Gutierrez, 2010).

In medical image processing it is necessary to determine the characteristics of the images obtained by the echocardiogram obtained from the different views, so segmentation is a key component in image processing to isolate physiological and biological structures of interest. In the next section we will talk about the techniques and applications of segmentation.

2 THEORETICAL AND CONCEPTUAL FRAMEWORK

The objective of image segmentation is to highlight the regions of interest, however, the problems encountered

when segmenting are changes in lighting, noise in the images or lack of structuring in the images (Gonzalez et al., 2018).

For this there are several segmentation techniques in medical images, the most used are the thresholding technique which differentiates objects in different levels of gray, border-based methods that look for similar areas from the threshold and morphological operations based on comparison of neighboring pixels.

In the case of cardiovascular disease, segmentation methods vary because echocardiographic views and points of interest are different. Recent studies have shown that automatic and semi-automatic segmentation methods based on deep learning have great potential for the evaluation of different cardiac structures, they can segment MRI images in real time with good precision segmentation of ventricles, as well as the endocardial edge (Cocosco et al., 2008) However, automating the image discriminates points of interest.

These techniques can be worked automatically or semi-automatically streamlining the processes and manually, but this consumes time because it requires knowledge of the medical area, however, it provides better information and analysis of the regions of interest. In this work, manual segmentation is proposed using already known techniques and under the specifications required by the specialist in parameters of aortic stenosis.

3 METHOD

For the detection of aortic stenosis, it is necessary to know the view of the healthy and calcified valve as in Figure 1. to understand the echocardiographic view to be worked with.

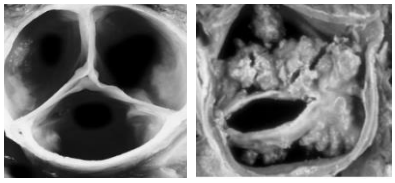

Figure 1. Image of healthy valve left and right stenosis in aortic valve. *(n.d.)* 5Minuteconsult.Com. Retrieved September 10, 2021, from https://5minuteconsult.com/collectioncontent/1-151405/diseases-and-conditions/aortic-valvular-stenosis

The echocardiographic view of the aortic valve is identified as in Figure 2. and one of the parameters that indicate the presence of aortic stenosis is the valvular area and the presence of calcium deposits that narrow the valve, for this segmentation process DICOM images of a patient with aortic stenosis with a resolution of 560x560 pixels were used, the methodology that was carried out with the help of the specialist was to identify the calcium deposits in the image, for the preprocessing stage the 2D medium filtering was used that is used for two-dimensional images to soften the image.

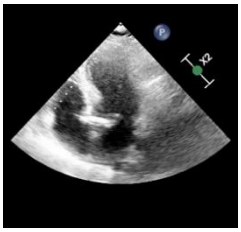

Figure 2. Image of the echocardiographic view of the aortic valve.

Once the image was smoothed, the different techniques of segmentation by contour or edge were tested, our region of interest in the image is the part of the middle where the opening of the valve is presented, determined the region or contour with the best technique found morphological operations were used to give structure to the image.

4 RESULTS

The results of the combination of the different segmentation techniques allows us to observe that the region of interest desired by threshold technique is better in this case, it was compared with the technique of region of edges and morphological functions, for this view of severe aortic stenosis should be considered all those regions that show calcium deposits, in the image it usually looks lighter in color as in Figure 3. The visual echocardiogram image shows no fragments compared to the segmented image on the right, in the background more traces of calcifications are shown.

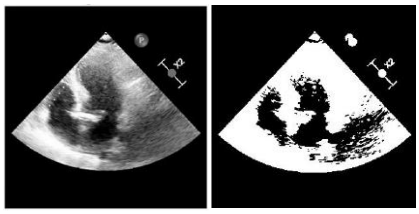

Figure 3. Aorta valve threshold segmentation.

5 CONCLUSIONS

A combination of manual segmentation techniques in aortic stenosis and segmentation obtained under the specialist supervision can be useful in determining whether or not the patient suffers from diseases has been presented. Although this manual technique is very laborious, it presents better indicators for the specialist and it be considered that this artisanal work would serve to semi automate segmentation for this echocardiographic view for future applications to neural networks.

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