Patient specific anatomy: the new area of anatomy based on computer science illustrated on liver

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Abstract

Background

Over the past century, medical imaging has brought a new revolution: internal anatomy of a patient could be seen without any invasive technique. This revolution has highlighted the two main limits of current anatomy: the anatomical description is physician dependent, and the average anatomy is more and more frequently insufficient to describe anatomical variations. These drawbacks can sometimes be so important that they create mistakes but they can be overcome through the use of 3D patient-specific surgical anatomy.

Methods

In this article, we propose to illustrate such improvement of standard anatomy on liver. We first propose a general scheme allowing to easily compare the four main liver anatomical descriptions by Takasaki, Goldsmith and Woodburne, Bismuth and Couinaud. From this general scheme we propose four rules to apply in order to correct these initial anatomical definitions. Application of these rules allows to correct usual vascular topological mistakes of standard anatomy. We finally validate such correction on a database of 20 clinical cases compared to the 111 clinical cases of a Couinaud article.

Results

Out of the 20 images of the database, we note a revealing difference in 14 cases (70%) on at least one important branch of the portal network. Only six cases (30%) do not present a revealing difference between both labellings. We also show that the right portal fissure location on our 20 cases defined between segment V and VI of our anatomical definition is well correlated with the real position described by Couinaud on 111 cases, knowing that the theoretical position was only found in 46 cases out of 111, i.e., 41.44% of cases with the non-corrected Couinaud definition.

Conclusions

We have proposed a new anatomical segmentation of the liver based on four main rules to apply in order to correct topological errors of the four main standard segmentations. Our validation clearly illustrates that this new definition corrects the large amount of mistakes

created by the current standard definitions, increased by physician interpretation that can vary from one case to another.