Topic:
Optimization of exposure values in computed tomography
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Introduction:
Stroke is one of the most frequent diseases in the human population, the second most frequent cause of death in economically developed countries. Early diagnosis and rapid treatment play a key role. Computed tomography can be used to diagnose stroke and select optimal therapy for the patient. However, rising CT scans increase the radiation exposure of the population.

Aim:
The aim of this work was to analyze the stroke protocol used in the Department of Imaging Methods in Pilsen, which is used in the diagnosis of acute cerebral ischemia. In addition, the aim was to design a modification of the protocol in order to reduce the radiation exposure, maintain the diagnostic quality of the image for evaluation and verify the feasibility in daily routine.

Methods:
The circulation times of the original (test) protocol were analyzed retrospectively. Based on this analysis, a shortened protocol was set according to test bolus performed in CT angiography. 134 patients were examined with this protocol. Subsequently, a reduction of the voltage to 70 kV was performed and 108 patients were examined. Further protocol adjustments were made according to the width of test bolus curve. 38 patients were examined with this protocol. Reduction of the radiation exposure was assessed by the standard dose indicators $CTDI_{vol}$ and DLP and then it was converted to effective dose. Furthermore, the diagnostic quality of the image for evaluation was assessed.

Results:
In the original (test) protocol, the mean value of the significant increase of density in ascending aorta during test bolus was 9.4 s (5–17 s), the mean maximum density was 24.7 s (9–26 s) and the mean value of no longer decreasing density was 21.5 s (15–47 s). The mean value of significant increase density in arteria cerebri media (ACM) during perfusion was 11.9 s (50–18 s), mean maximum density was 23.5 s (15–48 s), the mean value of maximum density in sinus sagittalis superior (SSS) was 23.5 s (15–48 s), the mean value of no longer decreasing density was 40 s (29–50 s). Except of one examination, all examinations of optimized protocols achieved sufficient image quality for diagnosis and decision for further therapy. Image data (number of layers) has been reduced from 4470 (original protocol) to 1204 (optimized protocol 3). All of the optimized protocols have reduced radiation exposure. Radiation exposure was most reduced in optimized protocol 3, where a dose reduction of 68% was achieved against the original protocol.

Conclusion:
This work has demonstrated that data of test bolus can be used effectively to set a perfusion scan. Moreover, with this modification, the radiation exposure can be significantly reduced with the simultaneous use of a reduced voltage value, while maintaining optimal diagnostic quality for evaluation.