

P101

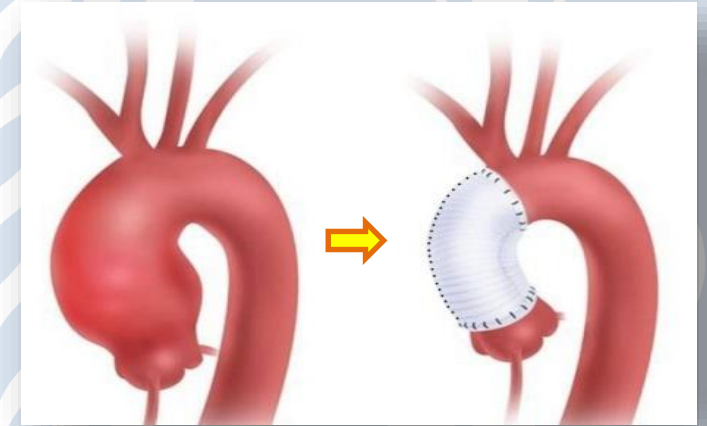
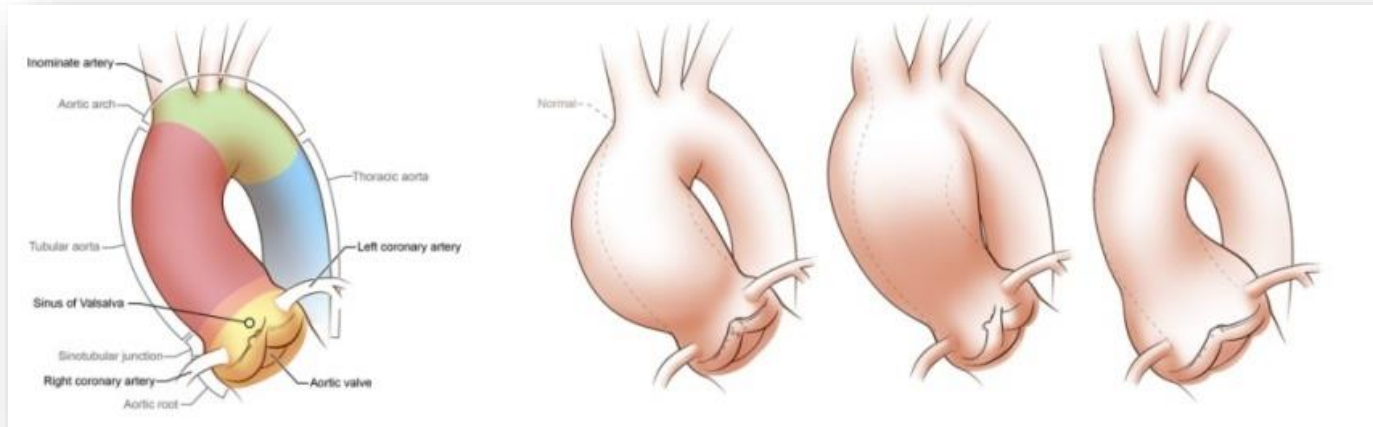
Development of the Expert AI System. Neural Networks and Pathology of the Thoracic Aorta

Gleb Kim – St. Petersburg State University Hospital, St. Petersburg, Russia

Ivan Blekanov – St. Petersburg State University, St. Petersburg, Russia

Murad Dadashov – St. Petersburg State University, St. Petersburg, Russia

Aortic aneurysm and dissection



- **49-69 years** – the age of patients
- **4000 patients** in the Russia annually
- **70-100% mortality** without surgery
- **Extremely high risk of sudden death!**

The main method of treatment is **aortic replacement**

Problems

- **There is a significant shortage of qualified personnel in the field of Cardiology.**
- **There are not enough experts and 24/7 decision-making assistance in the diagnosis and treatment of patients with cardiovascular diseases and with aortic pathology**
- **In emergency situations, the speed of decision-making depends on the qualifications**
- **Most of the research descriptions are done manually**
- **A significant part of the data is not accurately described, there is a risk of missing important parameters**
- **Difficulties in making decisions in borderline situations (patients in the "gray zone")**

How is the problem being solved now

- **Increasing the expertise of specialists and centers throughout the country**
- **Creation of specialized teams (Heart Team, Aortic Team)**
- **Telemedicine**
- **Development of Artificial Intelligence**

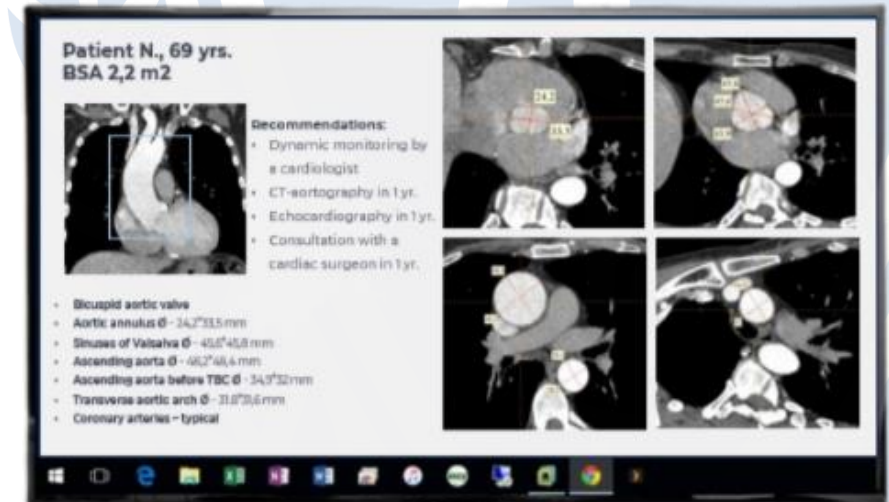
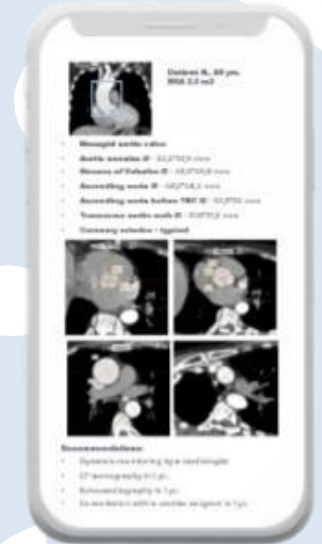
At the same time:

- **There are not enough experts and expert centers**
- **Experts are not available 24/7**

METHODS

- **Our solution** is a web service in the field of cardiology and cardiovascular surgery based on an ensemble of neural networks, which allows us to evaluate not only an obvious problem, but also borderline aortic changes with latent types of pathologies.
- **Second opinion:** help in making a decision to the doctor and objectification of the received information.

Now we are analyzing aorta and main branches



Our solution - Advantages

- 1. Increasing the expertise of specialists and centers throughout the country**
- 2. Possibility of planning heart operations**
- 3. Web service - remote access anywhere in the country**
- 4. Reliable data encryption system**
- 5. Response within 5-10 minutes**
- 6. The possibility of forecasting and screening**



METHODS

The main technology is the use of modern models of convolutional neural networks and transfer learning, which are used in the task of segmentation, including medical images

The software is aimed at analyzing textual and graphical medical data obtained as a result of hardware diagnostics of the cardiovascular system, such as Echocardiography and CT of the chest organs and aorta

- The Expert AI System allows you to increase the accuracy of measurements and reduce the time of image analysis
- On average, the analysis of images and clinical data takes no more than 5-10 minutes

The specialist receives a report with a detailed analysis of the aorta and recommendations for further patient management tactics

Technology



METHODS

Our neural network clearly defines where the aorta is

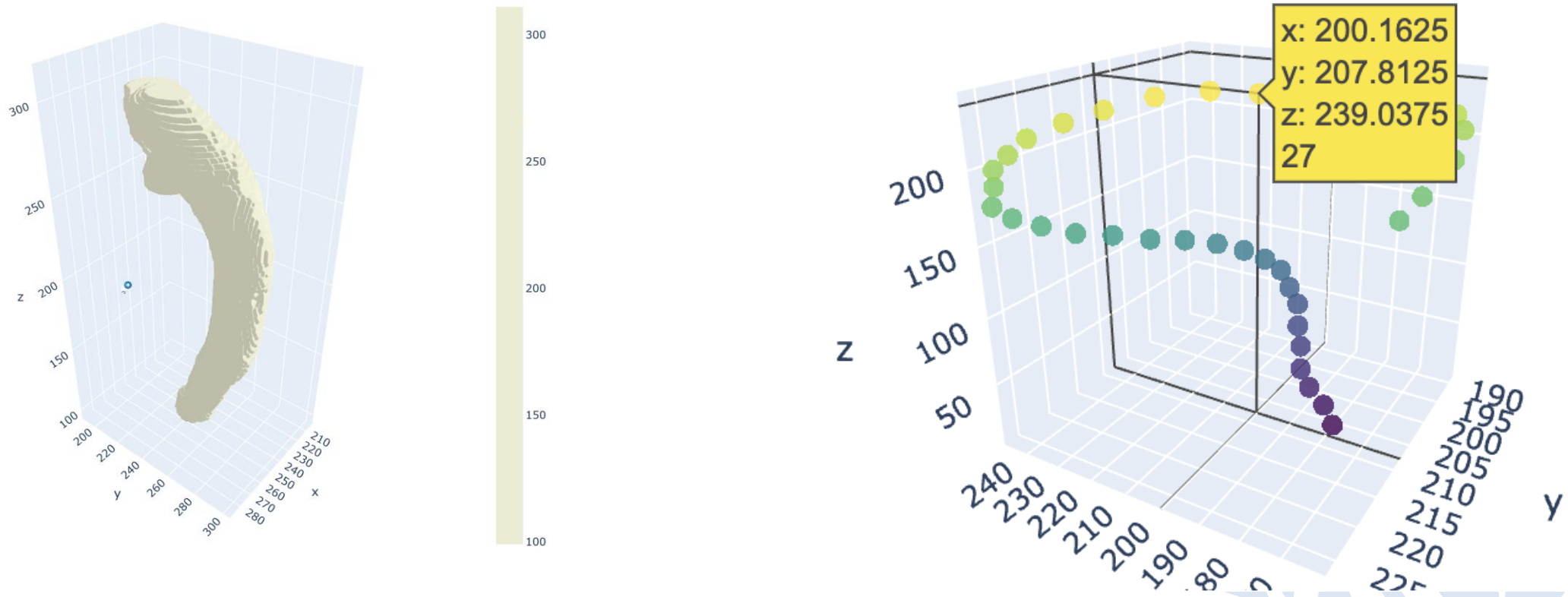


A model based on the U-Net architecture with transformers:

- ResNet-50 encoder
- TransUnet
- SWIN

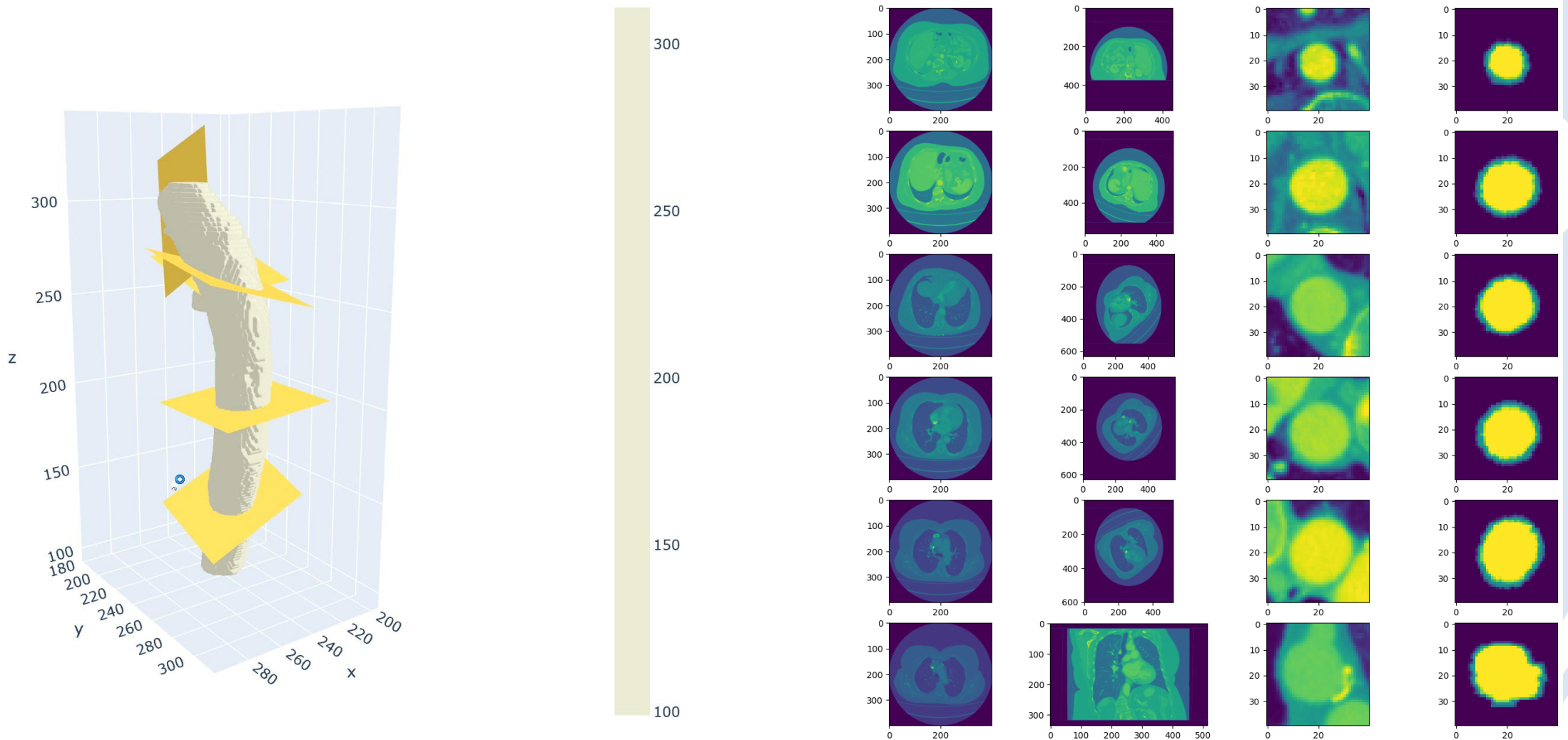
RESULTS

An example of reconstruction and selection of slices defines where the aorta is



RESULTS

An example of reconstruction and selection of slices



RESULTS

- 3 neural network models ("U-Net+ResNet-50", TransUnet and SWIN) have been developed and trained for automatic detection of the aorta on CT scans and methods for constructing its digital 3D model in full size.
- The resulting digital model of the aorta is planned to be used as a preparatory data processing procedure for neural network methods for:
 - segmenting the diameter of the aorta
 - searching and detailing pathological abnormalities in the aorta

CONCLUSIONS

- **The widespread use of artificial intelligence in cardiac surgery is just beginning. However, our team is one of the leaders in this area**
- **The lack of a sufficient number of experts in the field of aortic surgery, as well as the need for assistance in decision-making, is a key problem that can be solved through the use of an expert system**

Contact information

Gleb Kim

+7 (981) 811-29-45

Email: gikim.cor@gmail.com