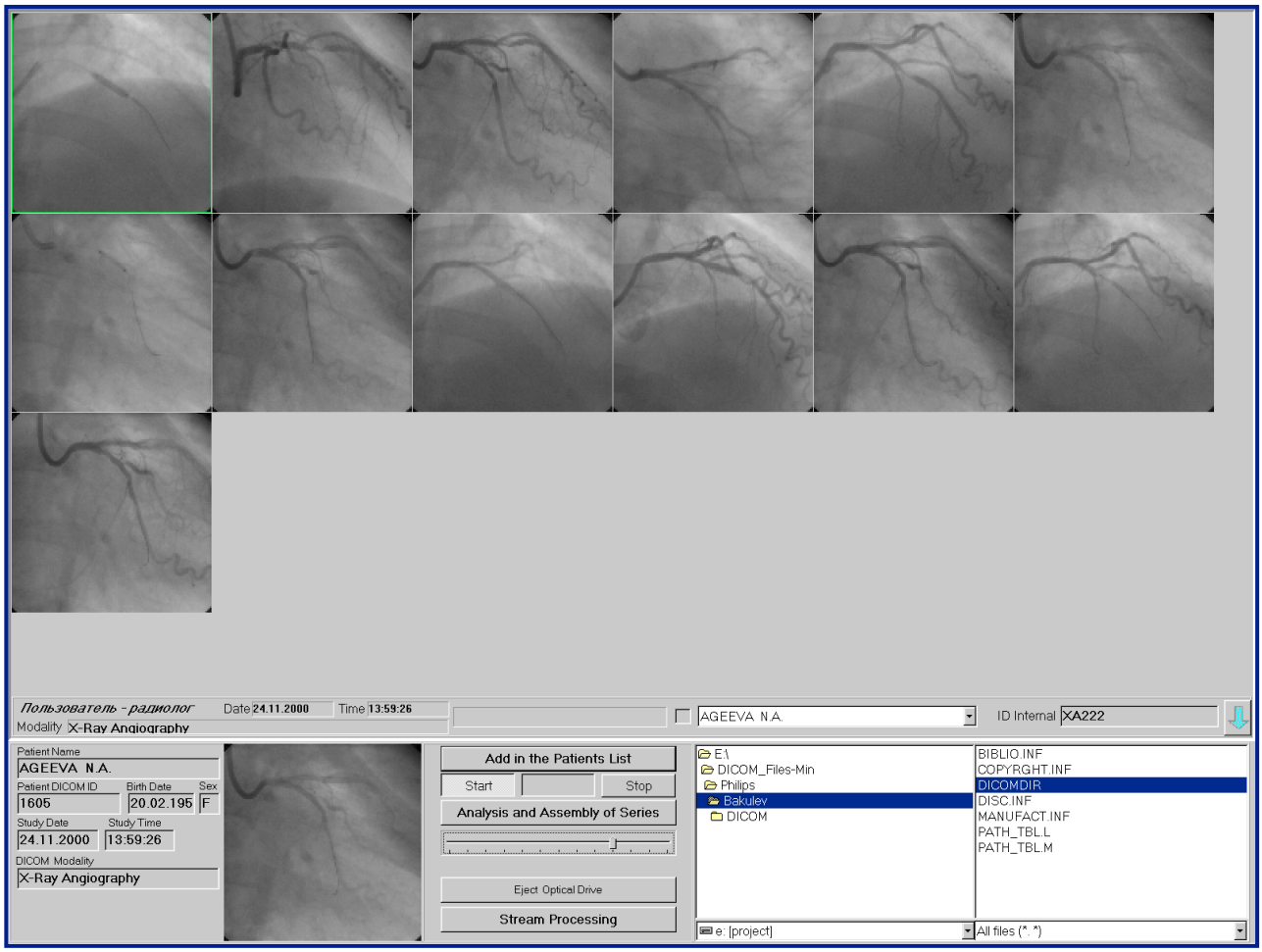
2D Processing and Visualization of DICOM Medical Images



Graphical Patient's Navigator - PATNAV

& Graphical DataBase - GDB

Graphical Patient's Navigator – **PATNAV**

The system starting of ***2D Processing and Visualization DICOM Medical Images*** of the **Graphical Patient-Navigator – PATNAV** (hereinafter, **Navigator**) will be loaded.

The Navigator providing the work with the patients' data, presented as **DICOM** files, consists of two parts:

- The **DICOM** Files **Navigator**.
- The Multi Window Graphical **Navigator** on **DICOM** patients' series.

These two parts collection is represented by the Graphical Navigator on patients and of their series which can work with **Graphical DataBase – GDB**, and without **GDB**. Exclusive methods of disassembly, the analysis and sorting of **DICOM** files, facilitating and accelerating users work with **DICOM** files are applied in the **Navigator**.

The whole panel, on which the basic controlling elements of the **Navigator** are located, can be shifted downwards. It increases a field of the survey of the chosen patient's representative images of series.

Shift down of the panel is carried out by pressing the button with an arrow descent, located at a right top corner of the panel. For return use the same button with an arrow upwards.

• Group 1. The DICOM Files Navigator.

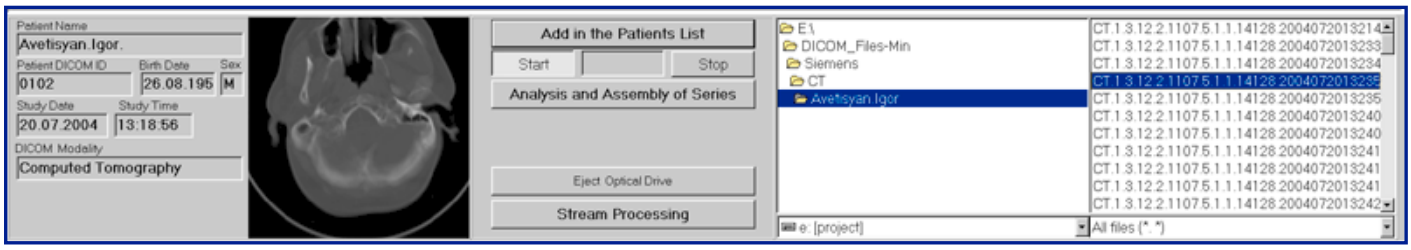
The bottom part of the **Navigator** Control Panel is **DICOM** Files **Navigator**. **DICOM Navigator** lies below the white division strip. **DICOM Navigator** serves for **DICOM** series manipulations:

- Searching of **DICOM** files or their series in directories;
- Representative images visualization of **DICOM** series or single **DICOM** files;
- Displaying the some parameters of **DICOM** files and their series;
- A group disassembling of **DICOM** files on different series;
- Assembly in a series of a single **DICOM** files being a single image, and representing one series.

The part of the Graphical **Navigator** which works with new **DICOM** files represents the interface divided into some parts, where one can find:

1.1. Specialized **File Navigator** for searching and selecting **DICOM** files.
1.2. Control unit of search, disassembly and assembly **DICOM** series processes.
1.3. Representative image of analyzed **DICOM** file or a series.
1.4. The data set on a patient and the research in the chosen **DICOM** file.
(Necessity of addition of parameters demands the coordination).

Fig. 1. Control Panel of **Graphical File Navigator**



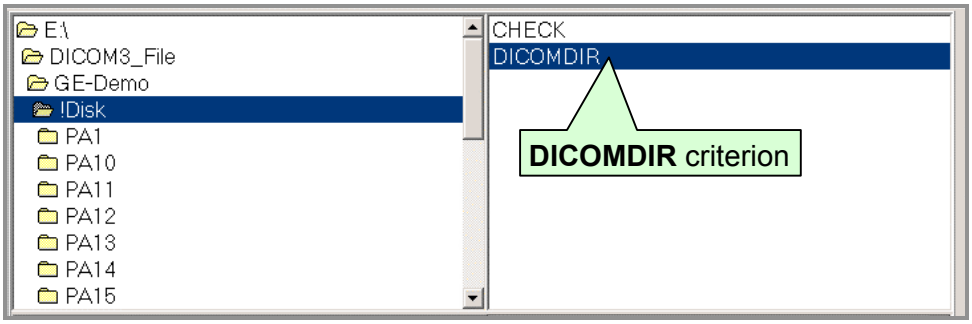
File Navigator has the left and right sub window for work with **DICOM** files. The guide on a tree of the logic disks is located on the left sub window of **File Navigator** chosen in its bottom part.

Folders of the chosen logic disk are displayed at the top part where a user is at the present time. Files located in these folders installed on the right sub window of **File Navigator.** Movements on folders and files are performed by the mouse in the general way.

If a user chooses a file which is **DICOM** file, the following occurs:

- The **DICOM** file disassembly on composing parts, representative image occurs and patient data fields and series data fields are filled.

Fig. 2. File Navigator with **DICOMDIR**

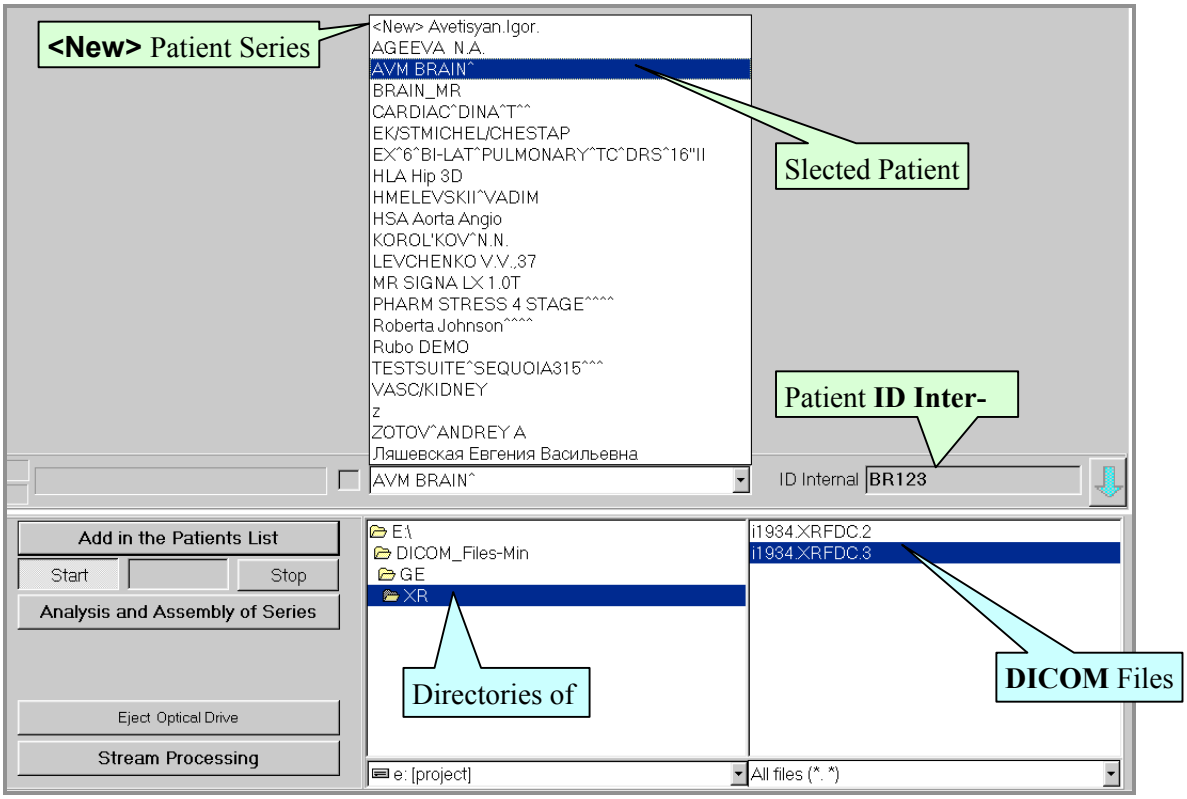


DICOM files might be automatically sorted by **DICOMDIR** criterion by selecting this criterion at the **File Navigator** bottom part**.** Otherwise all files which are in that folder will be displayed in it.

If the user has selected **DICOMDIR** criterion, all **DICOM** files will be found with the images, which are in **DICOMDIR** folders and lower. At the same time the data and representative images of **DICOM** series are filled, described in **DICOMDIR.**

That in both cases which have been mentioned above to see series in the Graphical **Navigator**, it is necessary to press "**Add in the Patients List"** button. As a result a name of the user patient list will be added and recorded the patients' name with a comment **<New>**. This comment designates, that **DICOM** series of this patient are accessible to viewing and processing, but are not imported in **GDB**.

Fig. 3. Functions of **File Navigator**



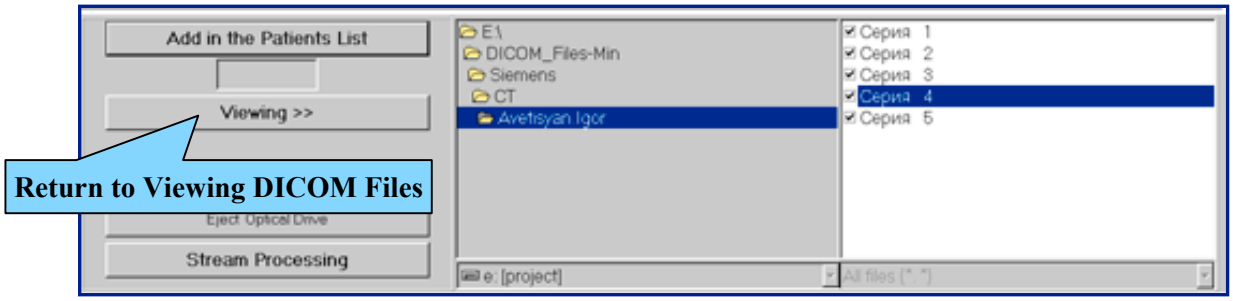
The Medical Administrator or the authorized user, can import or delete this series through the administrative menu of **GDB,** if necessary. The developed special modes of analysis of **DICOM** files with an opportunity of disassembling or assembling, depending on **DICOM** files, allow:

- To start analysis of series procedure, by pressing on **"Analysis and Assembly of Series"** button. As a result at the first stage all selected **DICOM** files with the images, that are in the current directory will be found.
- To assemble in a series group single **DICOM** files from single frame **DICOM** files.
- To disassemble all **DICOM** files on different series by the criteria described in **DICOM** files.

As a result of this procedure instead of sub window **File Navigator** the numbered series will appear.
Series parameters together with the Representative Frames can be seen by choosing this series with help of mouse.

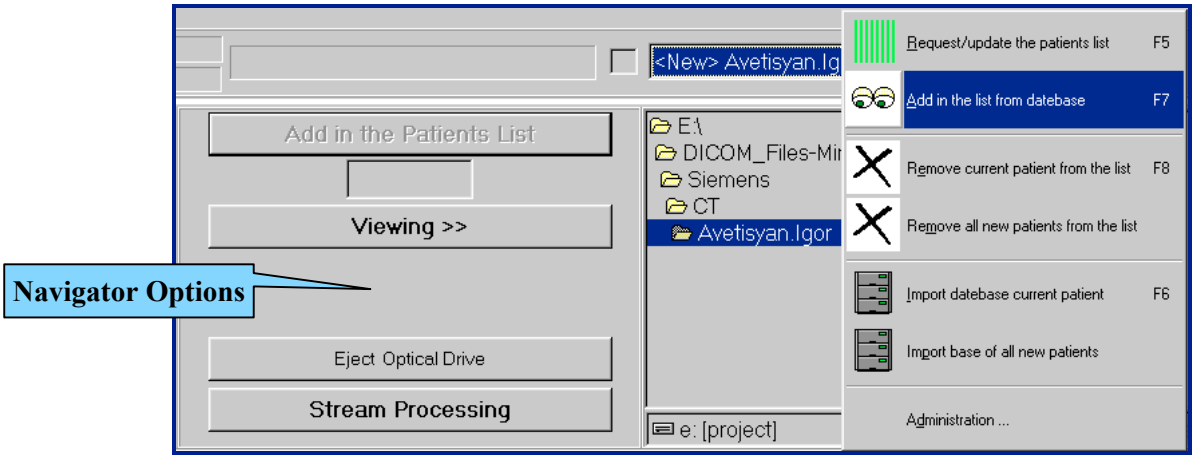
At desire of viewing and processing of these series they might be called in the Graphical **Navigator** by pressing **"Add in the Patients List"** button.

Fig. 4. File Navigator DICOM Files Viewing



Return to **File Navigator** for file navigation is performed by pressing **"Viewing"** button. Disassembling process on series is accompanied by indication of operation modes - the analysis of files and assembling of series.
Process of disassembling can be stopped by "**Stop**" button and is anew continued by "**Start**" button.

Fig. 4. File Navigator Options



On the panel two control buttons are located, related to special modes:
- **"Stream Processing"** button carries out a call (transition to it) of 2D Processing and Visualization component without loading new frames of a series in Stream Processing or Zoned Processing.
- "**Eject Optical Drive**" is used in two cases:
  - For an optical disk installation and viewing **DICOM** files located on it;
  - For the optical disk drive opening with a disk inserted into it.

Comment: If viewed from **DICOM** optical disk of a series is called for processing, the function of **"Eject Optical Drive"** button is blocked up to the end of research.

By pressing **"Eject Optical Drive"** button of an optical drive the disk drive will not be opened. If the optical disk is inserted, having in a root directory **DICOMDIR** file, there will automatically take place an analysis on series, by **DICOMDIR** criterion similarly as described above.

Comment: The Graphical Navigator allows importing the same **DICOM** file as by criterion **DICOMDIR**, and free disassembling of **DICOM** files. It allows working in some cases with the latent images of higher quality, as against registered by **DICOMDIR** criteria.

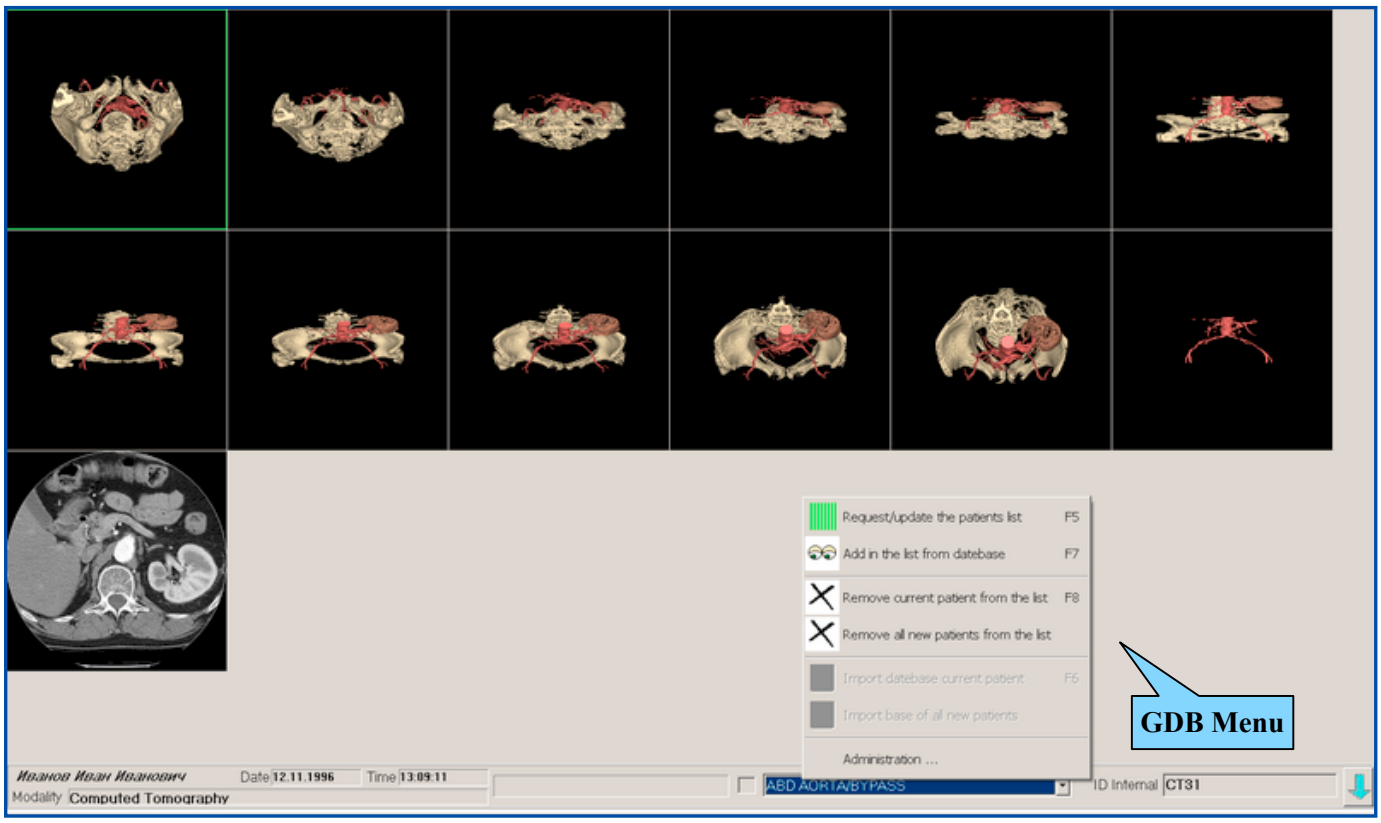
• Group 2. The Multi Window Graphical Navigator

The top part of the **PATNAV Navigator** control panel, being above a white strip of division, displays an area of work first of all with **GDB** Graphical Database**.**

The Navigator's top part which is not occupied by the control panel, is the **Multi Windows Graphical Navigator - PATNAV Graphical**, with the help of which the user calls series for viewing and processing in components of 2D Processing and Visualization - Stream Processing or Zoned Processing.

In the Graphical **Navigator** for each patient enlisted in a patient's list with whom the user works, all series are filled as the interface graphic elements and each cell at its choice is active. Extraction is visualized by a green framework on a contour of a cell.

Fig. 5. Navigator **PATNAV Graphical**



The menu with positions is opened by pressing the right button of the mouse on an active cell:

- **256*256** activates display of the each series representative frame in the image 256*256 cell format.

- **128*128** activates display of the each series representative frame in the image 128*128 cell format.

- "**All series request of the research**" allows in real time to receive from **GDB** the latest (all) researches of the patient.

- "**Send a series to other user for viewing**", from submenu, where chosen users of this **GDB** are listed, that allows to create record of that patient whose data are displayed on the display in patients list of the chosen user.

A call of the chosen series in Stream Processing or Zoned Processing with transition to the appropriate interface is performed by double click on the left button of the mouse.

Graphical DataBase – **GDB**

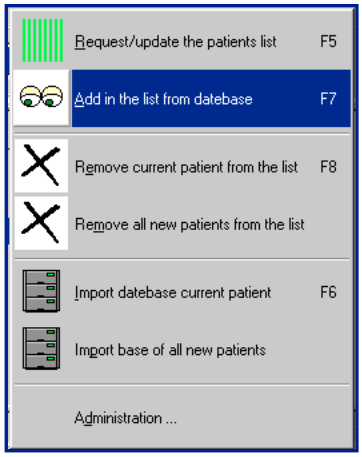
• The Navigator Work with GDB.

The part control panel of the **PATNAV** Navigator, responsible for the work with **GDB**, incorporates the latent and displayed resources:

2.1. **MENU** latent resource, which is called by the right button of the mouse, on this part of the Navigator control panel. The latent resource consists of the following functions:

2.1.1. Inquiry and updating function of the patients list, which the user works with. Loading of all data of patients series specified in this list is performed by activation of this function.
Simultaneously with it on a graphic part of the Navigator, for each patient of this list, windows are formed with the representative frames on all series of his/her shootings.
There is an indicator (green color) of loading of the above-stated elements from **GDB** on the left of the list.
On the right side of **ID Internal** window, where the patients clinical qualifier is displayed
(the patient's **ID Internal** for **GDB** is loaded at **DICOM Import** function).

Fig. 6. Menu **GDB** options



2.1.2. Function of addition in the user list from **GDB** other patients.
Activation of this function results in appearance of a window for working with **GDB** (search of the patient).
The result of search leads to addition chosen patient to the user list with simultaneous filling of his/her all data, including representative frames of series.

2.1.3. The removals function of the current record on the concrete patient from the user list.
Comment: The data are under **GDB** control and never delete.

2.1.4. Function is similar 2.1.3., but only deletes all patients from the user list, browsed as new and not yet imported in **GDB**.

2.1.5. Import function of new patient data in **GDB**. At the same time it's obligatory positions filling **ID Internal** without which import will not be performed (for example as **ID Internal** can be used the patient's history case number in the clinic).
Comment: **ID Internal** can not be repeated, it should be unique (provided by **GDB**).

2.1.6. All new patients import data Function in **GDB**.
Comment: Filling for all patients **ID Internal** is obligatory.

2.1.7. Administration functions for users' assignment and their rights, for definitions of all **GDB** components and a place of their physical accommodation on network resources.

2.2. The System multipurpose indicator showing processes:

- **DICOM** files disassembling on components in **Temporary Banks** for rapid access;
- The reading of a images series from **Temporary Bank** to memory station by starting Stream Processing or Zoned Processing.

2.3. Elements of displayed series parameters are located at the left part of the control panel:
Patient Name, Patient ID (Internal), Sex, Birth Date, Study Date, Study Time, Modality.

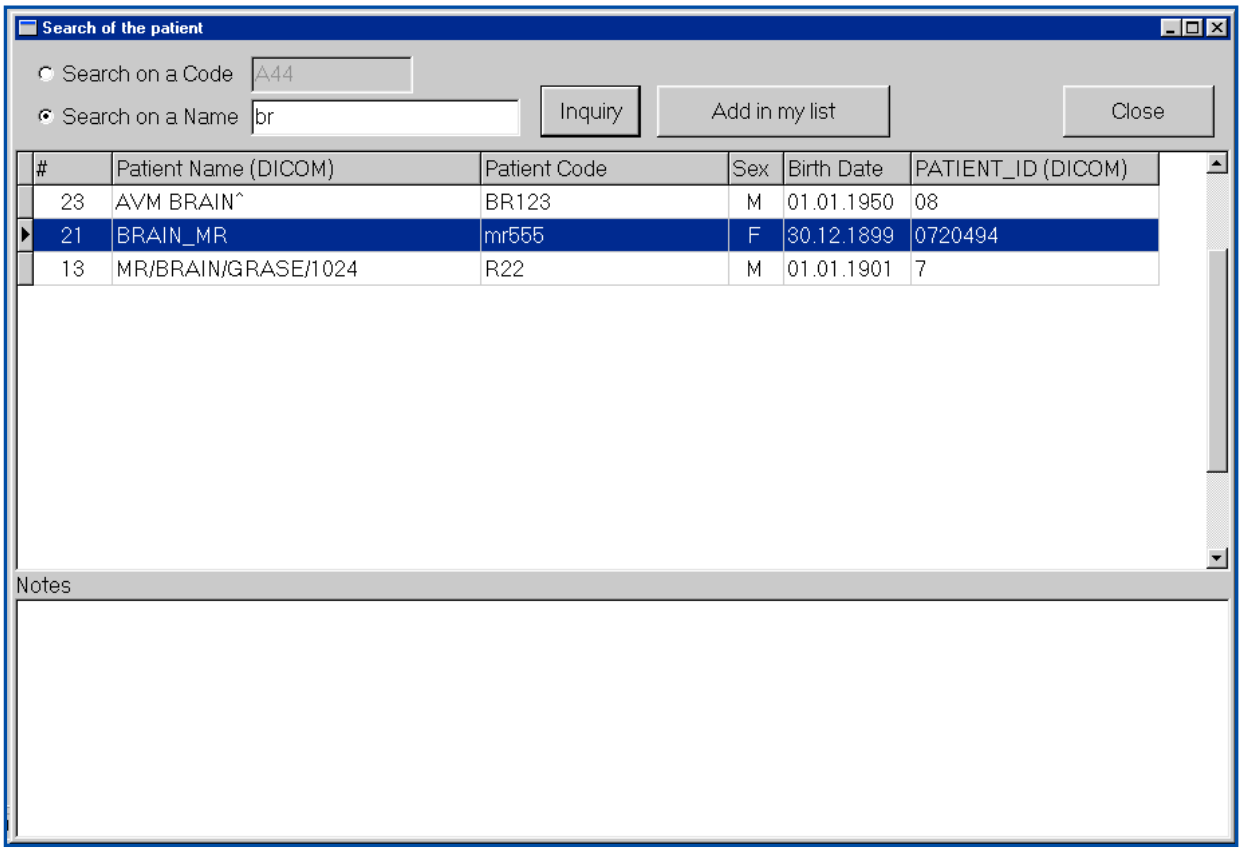
• Search and choice of patients in GDB.

The interface of patients search and choice in **GDB** constitutes minimally necessary table:

- The through serial number of the patient inside **GDB**.
- The given patient name from **DICOM** file (expansion demands the concordance).
  Restriction: The Same patient in all **DICOM** files should have identical record in «Patient Name» tag.
  In case of this rule infringement, the coordination for creation of a patient identification additional criterion, not stipulated in standard delivery version
  (as, inside clinical «**Internal Patient Name**»), is required.

- Patient's inside clinical code: **ID Internal**.
- Patient's **Sex**.
- Patient's **Birth Date**.
- Patient Code **Patient ID**, given from **DICOM** file.

Fig. 7. Patients search in **GDB**



Additional fields might be created of necessity and in coordination. Patients Search is possible by two criteria:

- by **ID Internal** (inside clinical code),

- by contextually, by typing in the appropriate field several letters of the patient name, sharply narrowing a circle of a choice (amount) by pressing **Search** button.

When the patient is chosen also the cursor is on his/her name, by pressing **"Add in List"** button, filling the patient's representative frame of a series is occurred.

• Administration GDB.

For administrative functions call of **GDB** management it is necessary at loading **PATNAV**. Thus **Administration of a database** interface will be opened**,** where **the User Name** is necessary to specify **in the** column **Administrator's** name and in the password column to enter the password of the administrator database.

By pressing button **"OK"** the connection will take place with **GDB** and interface **Administrator,** where a set of tables and elements of their management will appear.

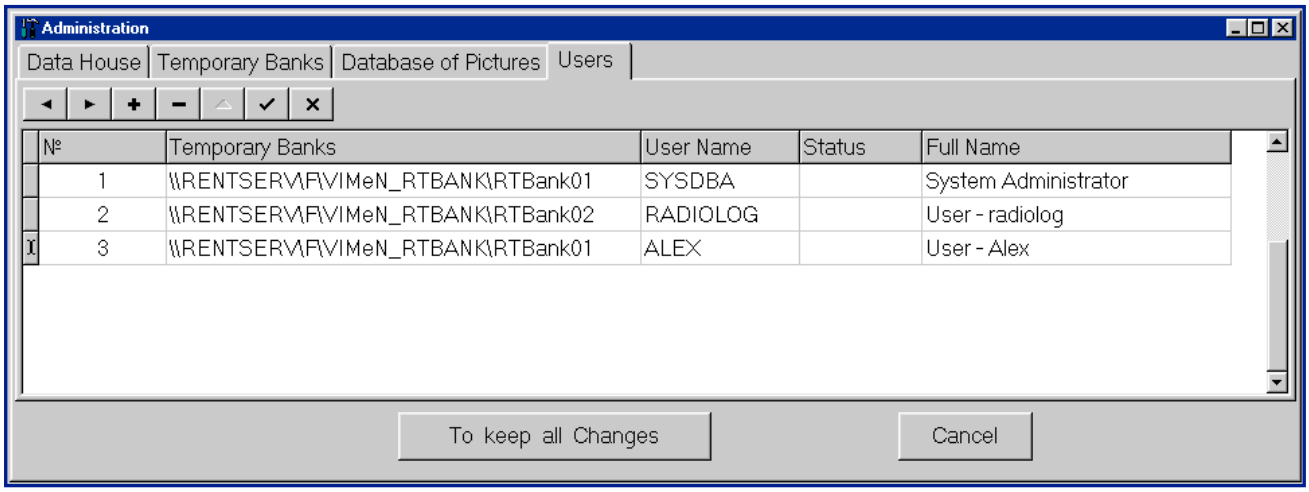
For all tables of **GDB** administration submitted above, elements of management are:

1. The Arrow (pointer) to the left carries out transfer to a next up line in tables.
2. The Arrow (pointer) to the right carries out transfer to a next down line in tables.
3. The Mark **"+"** adds a new line of the table.
4. The Mark **"-"** deletes a line of the table.
5. The Arrow (pointer) upwards "/\".
6. The Mark a birdie **"\/"** saves all changes.
7. The Mark a dagger **"X"** does not save all changes.

The following kinds of administration are registered, chosen by bookmarks in the appropriate tables:

1. **Users.**
2. **Database of Pictures.**
3. **Temporary Banks.**
4. **Patients Data House.**

Fig. 8. Administration **GDB** of Users Functions



1.1 In the **GDB** users table the columns are filled:

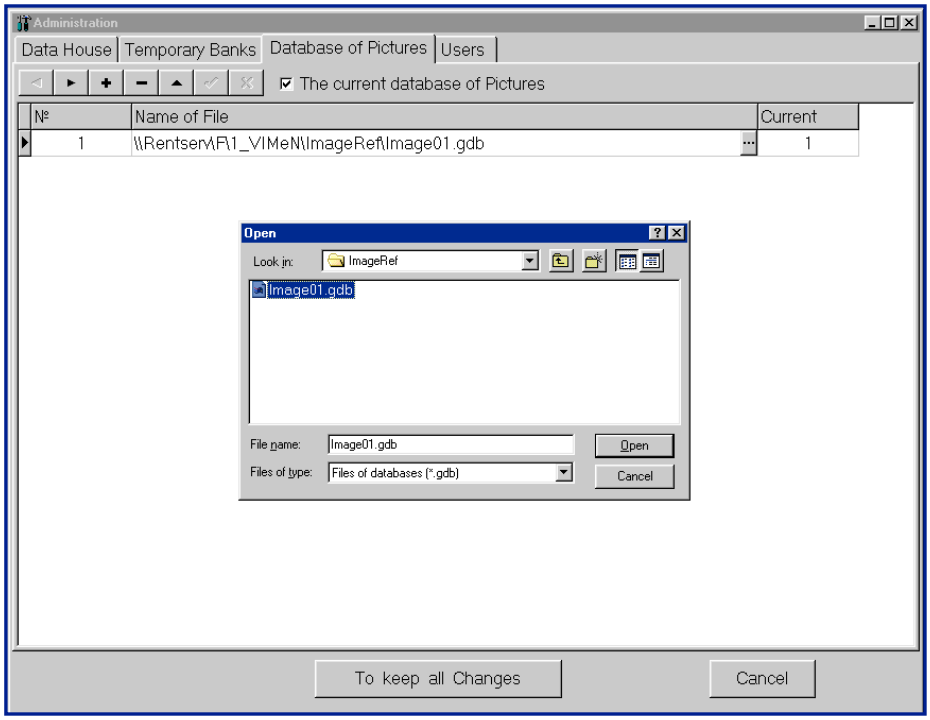
- **User Name – login.**

- **Status -** It is filled on the roles by the attributed users, for example:
  Medical Administrator, Medical Writer, Medical Reader, Medical Viewer …

- **Full Name,**

- **Temporary Bank** to which the given user is attached. The choice of **Temporary Bank** is made by pressing the mouse left button on the **Temporary Bank** cell of this user. As a result from the right side of this cell appears a button with an arrow, by pressing on which in **File Open** dialogue find in network **Temporary Bank** of this user. The way to this bank directory as result of search is kept by pressing button **"To keep all Changes"**.

Fig. 9. Administration **GDB** Functions of **Representative Frames** database



1.2 **GDB** Data base of representative frames. The table has two fields:

- File name database of the representative frames - **Name of File**.
- Current number of representative frames database - **Current**.

The current database of pictures, after the expiration of certain time, might be closed (stopped its expansion) and the new database of the representative frames is begun. It is done for reduction of each part volume and work acceleration with it (including service).

Representative frames database the which is extracted can be made active, i.e. working, by activation of **"the current Database of Pictures"** option. The choice of a file name can be correctly initialized (created or written down) through **File Open** dialogue.

Fig. 10. Administration Functions **GDB** of **Temporary Banks**

1.3 **Temporary Banks**. The table has one cell (**Path** - a way) which also can be found through **File Open** dialogue. All active **Temporary Banks** are specified in the table, work with **GDB.**

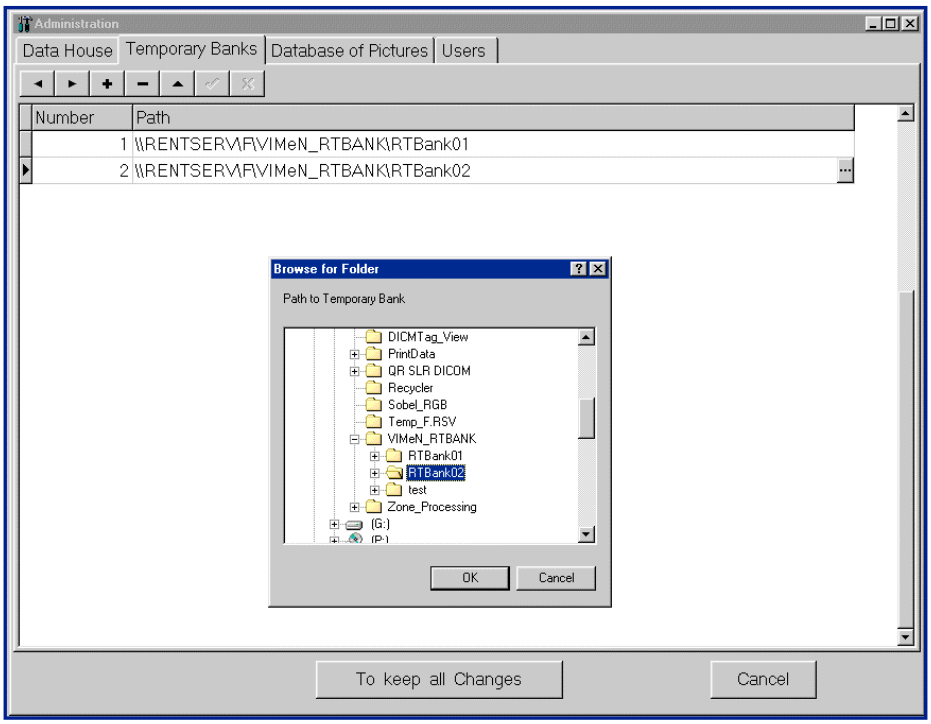
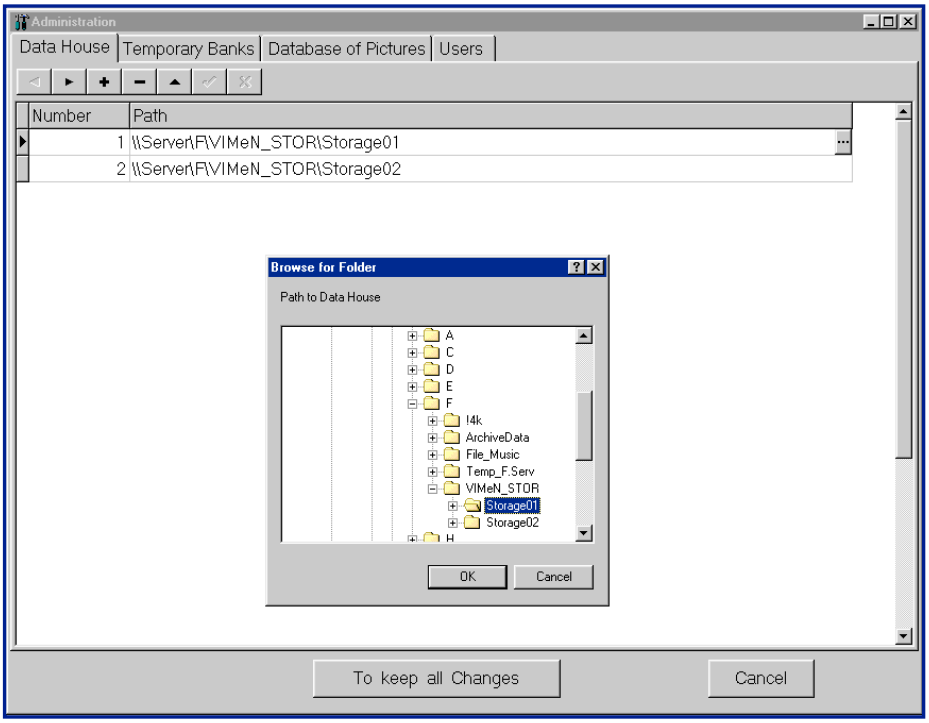


Fig. 11. Administration Functions **GDB** of **Patients Data House**

1.4 The centralized data storage **(Patients Data House)**. The table has a unique field and some records in **Path** cells, which through **File Open** dialogue can be specified for all banks of the centralized data storage, placed on different machines and on different files.



Administration finishing stage is saving of all administration changed results (whether or not) by pressing **"To keep all changes"** button (otherwise on button **"Cancel"**).

- **Example of work with a** Graphical Patients-Navigator **and** GDB

Fig. A. Analysis and Assembly of Series in the **PATNAV**

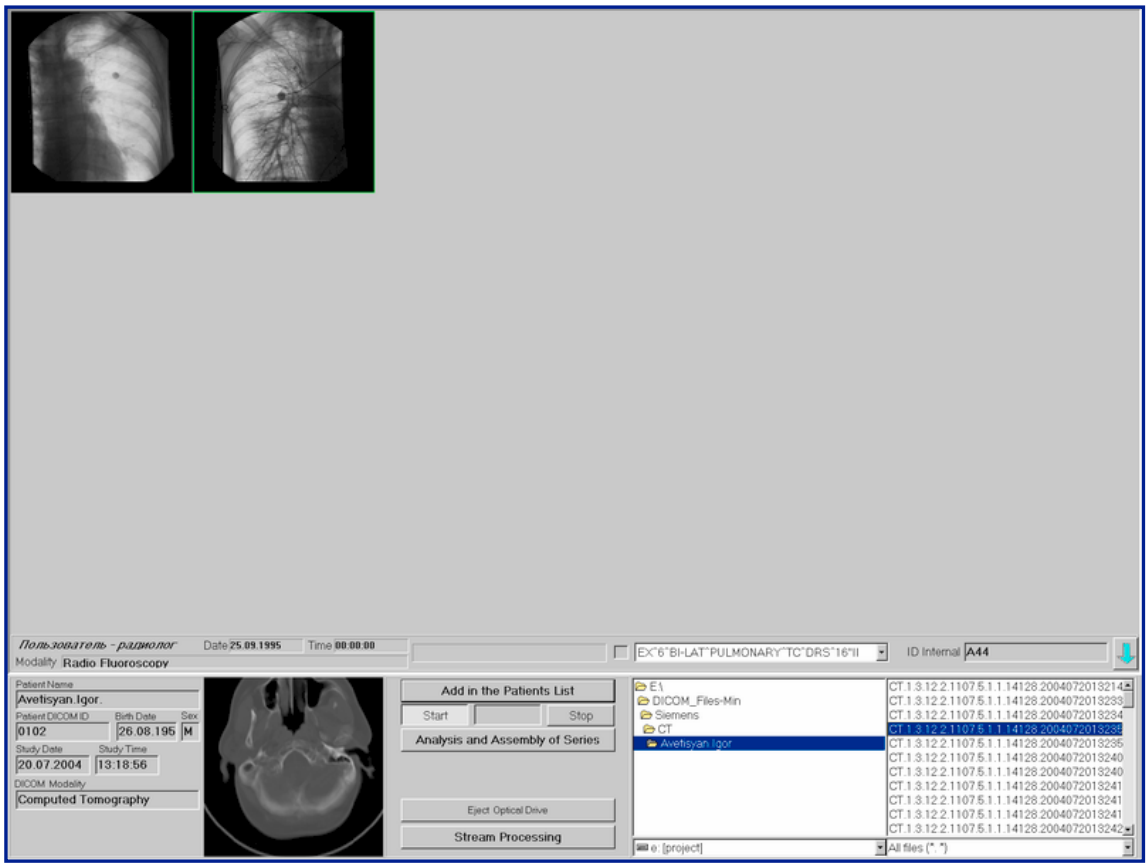


Fig. B. Choice of the Patients from a Patients List in the **PATNAV**

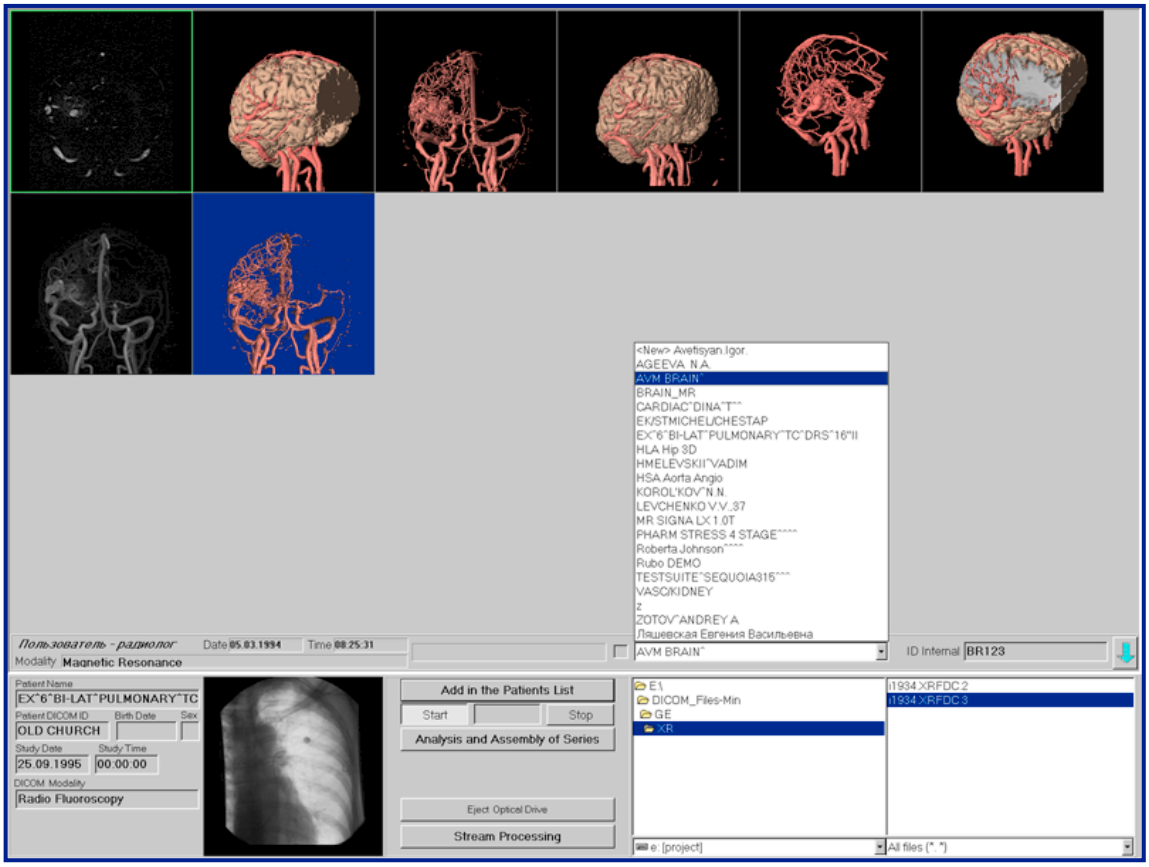


Fig. C. Viewing and Add Patients List or Patients Series

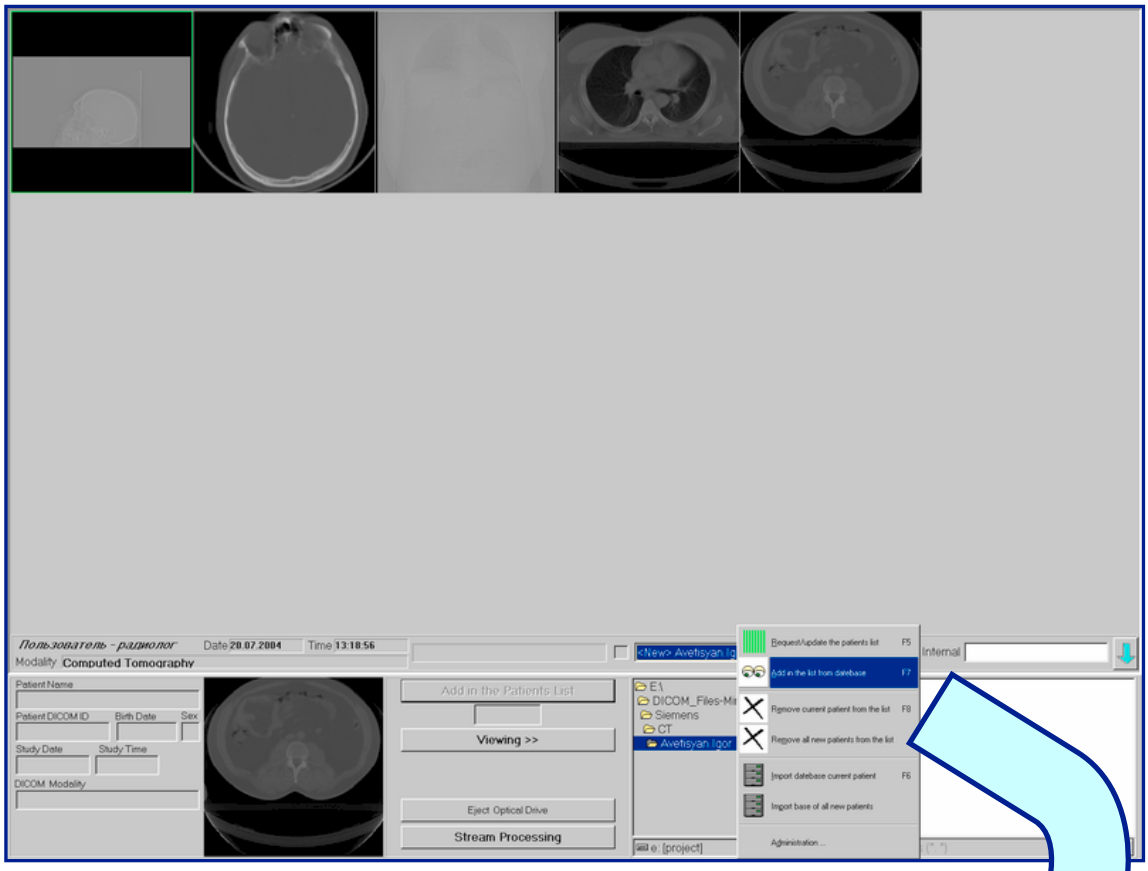


Fig. D. Choice of the Patient Series in **GDB**

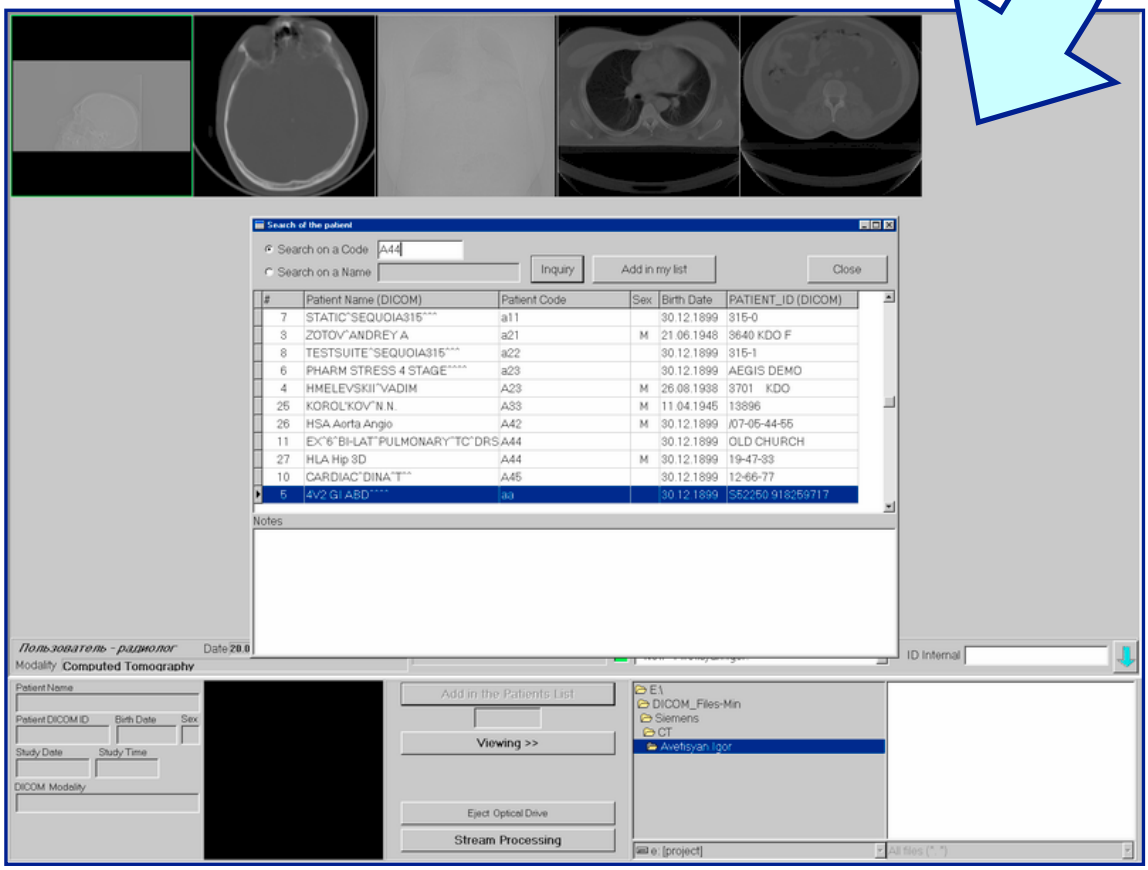
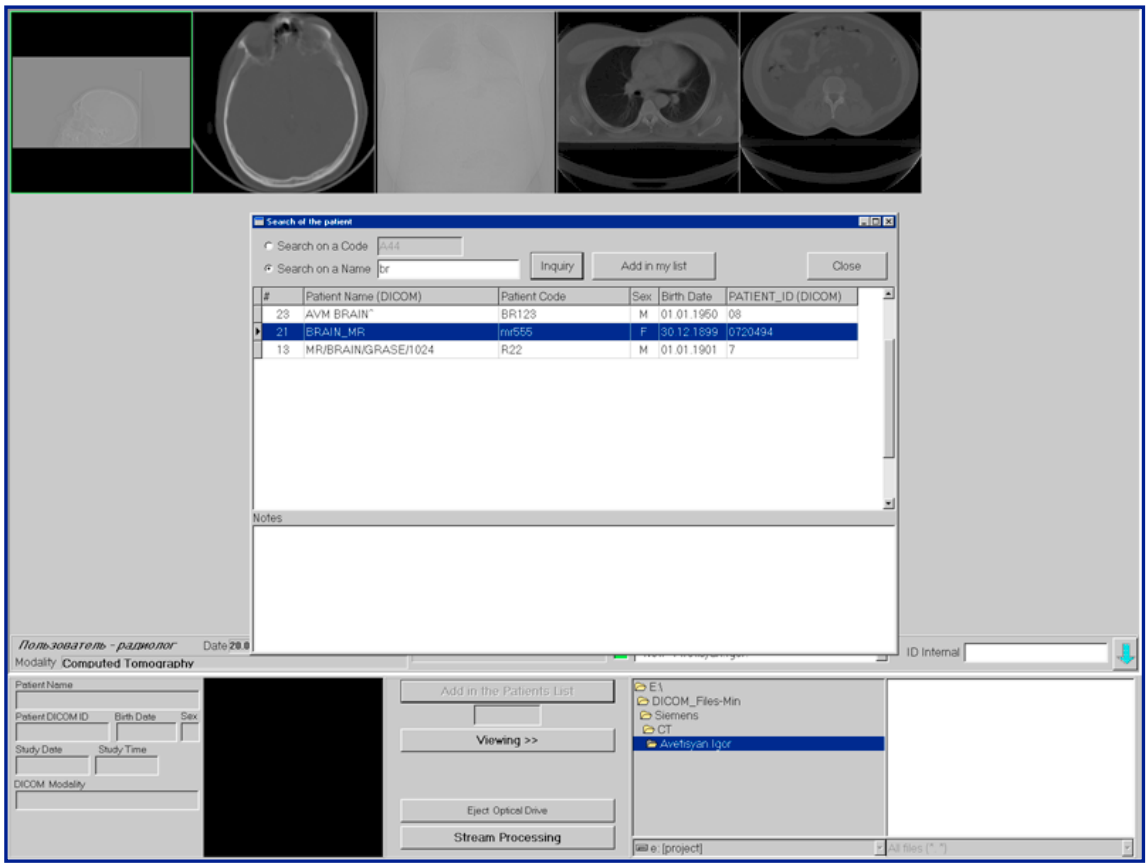


Fig. E. Select of the Patient Series in **GDB**



- **Finish**