

Development of Decision-Making Software for Patients With Kidney Stones

Martins Krasnovs¹, Zigurds Markovics², ^{1,2}Riga Technical University

Abstract—The paper discusses the development of decision-making software for patients with kidney stones. Computerized decision-making about treatment choices for patients with renal stones is step-by-step described in this paper. Medicine is one of the sectors where computerized decision-making is being used more often. One of the key elements of expert systems – building a knowledge base that is based on recommendation fund, known as „Guidelines”, is discussed. The paper discusses the most frequently used therapies. Examples of decision trees and production rules are shown.

Keywords—Decision making, kidney stones, production rules.

I. INTRODUCTION

Nowadays more and more attention is paid to computerized decision-making processes. Different computer programs are developed which allow us to make a decision in several sectors. Such software is designed to facilitate daily work of specialists. Medicine is one of the sectors where computerized decision-making is being used more often. One of the latest software is the computerized decision-making of treatment choices for patients with kidney stones. The existing knowledge of this sector is summarized in the collection of recommendations, known as „Guidelines”, which is useful for the computerized decision-making development process.

Kidney stones can be found in an average of 10 – 20 of 10,000 people. The number of patients with kidney stones in the developed countries is gradually increasing. One of the factors why this is happening is the increased protein usage in the diet, inactive lifestyle or lack of fluid intake [3], [12], [14]. In simple cases kidney stones can be dissolved using medications, and stones will pass out by themselves [15]. In more complex situations, it is necessary to perform multiple surgical procedures and patients may need to stay in hospital for several days [2, 13].

II. PROPOSED METHOD

To create a computerized decision-making of treatment choices for patients with kidney stones, guidelines of urolithiasis were used [2]. There are several steps to develop a fully working software, starting with knowledge base creation and finishing with computer program testing.

Step 1) At the beginning all possible diagnoses must be selected for patients with kidney stones. Kidney stones can be located in urinary tract, kidneys and bladder. This paper provides decision-making in cases when the stones are only in kidneys. Regardless where kidney stones are, diagnosis is divided in two parts:

- Uncomplicated kidney stones (without infection);
- Complicated kidney stones (infectious).

In this case there are only two, if kidney stone features (composition, size, and location in the kidney) are not mentioned. Problems begin when it is necessary to choose the optimal therapy, where all stone features and indications, as well as contraindications must be examined and used [2], [3].

Step 2) All possible therapies must be selected. Therapies can be divided in two groups [4]:

- Conservative therapy;
- Surgical therapy.

Conservative therapy holds all types of drug treatment, from simple analgesics to oral chemotherapy. Surgical therapies are [2], [5], [6], [10], [11]:

- Stenting;
- Extracorporeal shock wave lithotripsy (ESWL);
- Ureteroscopy (URS) or Retrograde Intrarenal Surgery (RIRS);
- Percutaneous nephrolithotomy (PNL);
- Laparoscopy;
- Open Surgery.

After that a priority table of treatment choices must be created using composition and size of renal stones. Unfortunately practice shows that renal stone features give no information about the patient, but this kind of information is crucial and must be used for the decision-making [9], [16]. Each therapy gets its own indications that allow to use the selected therapy but there can be one or more contraindications prohibiting the selected therapy. Table 1 gives an example of one of the therapies [2], [3], [8], [9].

Step 3) Since the knowledge base structure is based on decision trees, the information is stored using production rules. Production rules consist of a condition (IF) and action (THEN). Formally it is written: IF (condition) and THEN (action).

The decision tree consists of decision nodes (Indications), chance nodes (contraindications) and end nodes (therapies) [7]. Decision trees must be created for each indication. To make this process easier all indications and contraindications are indexed and later these indexes are used during the programming process. Ureteroscopy indication indexes are [1]:

- Ind6_1 Unsuccessful ESWL therapy;
- Ind6_2 Nephrocalcinosis;
- Ind6_3 Severe obesity;
- Ind6_4 Stones in kidneys and urinary tract at the same time.

The contraindications are:

- K_1 Uncontrolled urinary tract infections (UTIs);
- K_4 Intrarenal anatomical abnormalities;
- K_5 Urinary stasis;
- K_14 Bleeding diathesis.

The ureteroscopy decision tree can be seen in Fig. 1.

TABLE I
INDICATION AND CONTRAINDICATION TABLE FOR URETEROSCOPY AND EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY

Therapy	Indications	Contraindications
Ureteroscopy (URS)	<ul style="list-style-type: none"> Unsuccessful ESWL therapy Nephrocalcinosis Severe obesity Stones can be found in both kidneys and urinary tract 	<ul style="list-style-type: none"> Uncontrolled urinary tract infections (UTIs) Urinary stasis Intrarenal anatomical abnormalities Bleeding diathesis
Extracorporeal shock wave lithotripsy (ESWL)	<ul style="list-style-type: none"> Calcium stones smaller than 20 mm Cystine stones smaller than 20 mm Diabetes Hypertension Respiratory diseases Patient with a single kidney Not allowed to use anesthesia and open surgery Patient who recently had a surgery 	<ul style="list-style-type: none"> Pregnancy Severe skeletal malformations Arterial aneurysm Uncontrolled urinary tract infections (UTIs) Severe obesity Non-functioning kidney Urinary stasis Prolapsed kidney Unsuccessful ESWL therapy Intrarenal anatomical abnormalities
Laparoscopy and open surgery	<ul style="list-style-type: none"> Infectious stone burden Unsuccessful ESWL, PNL and URS therapies Intrarenal anatomical abnormalities Severe obesity Non-functioning kidney Severe skeletal malformations Arterial aneurysm Prolapsed kidney 	<ul style="list-style-type: none"> Blood coagulation problems

In order not to draw exactly the same four trees, where the only difference is decision nodes (Indications), a decision tree was drawn where all four indications are at the decision node and indexed it with Ind_6.

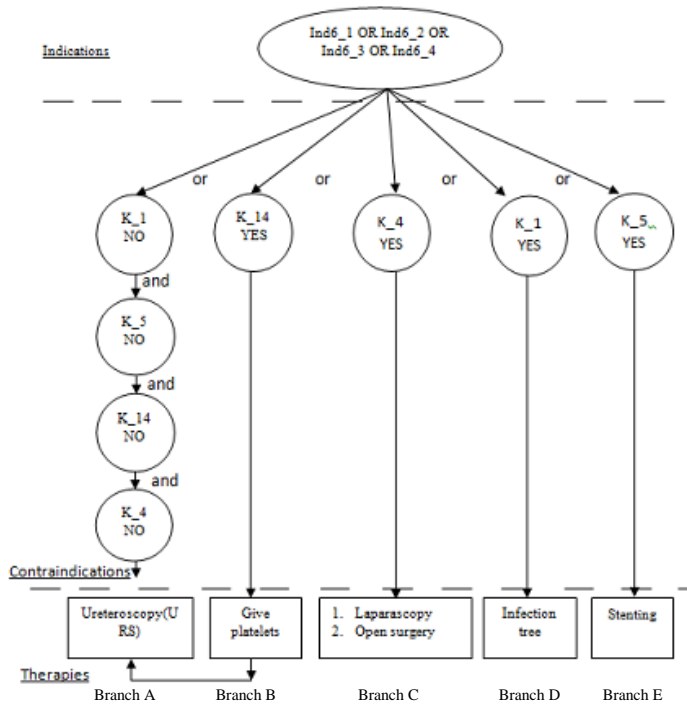


Fig. 1. Example of Ureteroscopy decision tree.

Step 4) The next step is to write the production rules. At the beginning the rules are written for each branch separately and afterwards all possible branch combinations must be described. Note: Not all production rules are shown:

PR 1 (Branch A)

IF there is Ind_6 AND (no K_1) AND (no K_5) AND (no K_14) AND (no K_4) **THEN** „Ureteroscopy”;

PR 2 (Branch B)

IF there is Ind_6 AND (yes K_14) AND (no K_4) AND (no K_1) AND (no K_5) **THEN** „Give Platelets” AND „Ureteroscopy”;

PR 3 (Branch D+E)

IF there is Ind_6 AND (yes K_1) AND (yes K_5) AND (no K_14) AND (no K_4) **THEN** go to „Infection tree”;

PR 4 (Branch C+D+E)

IF there is Ind_6 AND (yes K_4) AND (yes K_1) AND (yes K_5) AND (no K_14) **THEN** go to „Infection tree” AND „Use Laparoscopy or Open Surgery”;

PR 5 (Branch B+C+D+E)

IF there is Ind_6 AND (yes K_4) AND (yes K_1) AND (yes K_5) AND (yes K_14) **THEN** go to „Infection tree” AND „Give platelets” AND „Use Laparoscopy or Open Surgery”;

By the same technique decision trees are made for all indications, followed by all possible production rule combinations between the tree branches.

Extracorporeal shock wave lithotripsy has much more indications and contraindications as it can be seen in Table 1. ESWL indications are [1]:

- Ind5_1 Calcium stones smaller than 20 mm;
- Ind5_2 Cystine stones smaller than 20 mm;

Ind5_3 Diabetes;
 Ind5_4 Hypertension;
 Ind5_5 Respiratory diseases;
 Ind5_6 Patient with a single kidney;
 Ind5_7 Not allowed to use anesthesia and open surgery;
 Ind5_8 Patient who recently has had a surgery.

ESWL contraindication indexes are:

K_1 Uncontrolled urinary tract infections (UTIs);
 K_4 Intrarenal anatomical abnormalities;
 K_5 Urinary stasis;
 K_6 Prolapsed kidney;
 K_7 Non-functioning kidney;
 K_8 Severe skeletal malformations;
 K_10 Arterial aneurysm;
 K_11 Severe obesity;
 K_12 Unsuccessful ESWL therapy.

ESWL decision tree can be seen in Fig. 2.

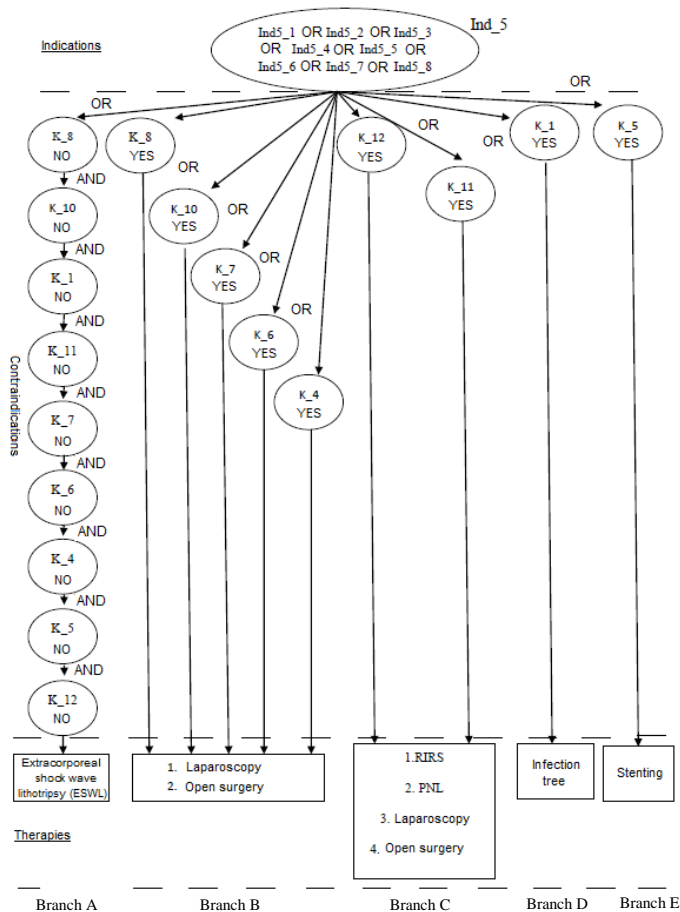


Fig. 2. Decision tree of Extracorporeal shock wave lithotripsy.

Production rules are written for each branch separately and for all possible combinations too. Note: Not all production rules are shown.

PR 1 (Branch A)

IF there is Ind_5 AND (no K_8) AND (no K_10) AND (no K_1) AND (no K_11) AND (no K_7) AND (no K_6) AND (no K_4) AND (no K_5) AND (no K_12)
THEN „ESWL” therapy;

PR 2 (Branch D)

IF there is Ind_5 AND (yes K_1) AND (no K_5) AND (no K_12) OR (no K_11) AND (no K_8) OR (no K_10) OR (no K_7) OR (no K_6) OR (no K_4);
THEN go to „Infection tree”.

PR 3 (Branch E)

IF there is Ind_5 AND (yes K_5) AND (no K_1) AND (no K_11) OR (no K_12) AND (no K_8) OR (no K_10) OR (no K_7) OR (no K_6) OR (no K_4)
THEN „Stenting”;

PR 4 (Branch B+D)

IF there is Ind_5 AND (yes K_10) OR (yes K_8) OR (yes K_7) OR (yes K_6) OR (yes K_4) AND (yes K_1) AND (no K_5) AND (no K_12) OR (no K_11)
THEN go to “Infection tree” AND „Use Laparoscopy or Open Surgery”;

PR 5 (Branch D+E)

IF there is Ind_5 AND (yes K_1) AND (yes K_5) AND (no K_8) OR (no K_10) OR (no K_7) OR (no K_6) OR (no K_4) AND (no K_12) OR (no K_11)
THEN go to “Infection tree” AND „ESWL” therapy;

PR 6 (Branch B+C+D)

IF there is Ind_5 AND (yes K_8) OR (yes K_10) OR (yes K_7) OR (yes K_6) OR (yes K_4) AND (yes K_12) OR (yes K_11) AND (yes K_1) AND (no K_5)
THEN go to “Infection tree” AND „Use Laparoscopy or Open Surgery”;

PR 7 (Branch B+C+E)

IF there is Ind_5 AND (yes K_8) OR (yes K_10) OR (yes K_7) OR (yes K_6) OR (yes K_4) AND (yes K_12) OR (yes K_11) AND (yes K_5) AND (no K_1)
THEN “Stenting” AND „Use Laparoscopy or Open Surgery”;

PR 8 (Branch B+C+D+E)

IF there is Ind_5 AND (yes K_8) OR (yes K_10) OR (yes K_7) OR (yes K_6) OR (yes K_4) AND (yes K_12) OR (yes K_11) AND (yes K_5) AND (yes K_1)
THEN go to “Infection tree” AND „Use Laparoscopy or Open Surgery”.

THEN go to “Infection tree” AND „Use Laparoscopy or Open Surgery”.

There is a possibility that the decision must be made by moving from one tree to another. The decision process can be cyclic. Such an example is the production rule 2 (Branch D) from Extracorporeal shock wave lithotripsy tree. It says that the therapy is “Infection tree”. If the patient has got the uncontrolled urinary tract infection (UTIs), it will always lead to the infection tree. This tree differs from the others, because

there is only one contraindication which determines the sequence of therapy. The contraindication is:

K₁₃ Situation is life-threatening. Act immediately.

If the decision tree gives more than one therapy, all of them must be performed in the given order.

The infection decision tree can be seen in Fig. 3.

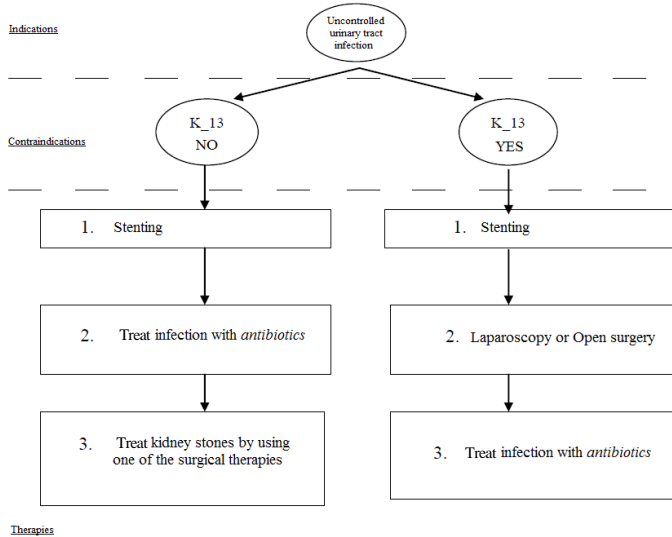


Fig. 3. Infection decision tree.

The production rules are:

- PR 1 **IF** there is (UTI's) AND (no K₁₃)
THEN "Stenting"
 AND "Treat infection with antibiotics"
 AND "Treat kidney stones by using one of the surgical therapies";
- PR 2 **IF** there is (UTI's) AND (yes K₁₃)
THEN "Stenting"
 AND "use Laparoscopy or Open surgery"
 AND "Treat infection with antibiotics".

There is a possibility that the decision can be made by cyclic operations within one tree. Such an example is the Laparoscopy and Open surgery decision tree. Indications and contraindications can be seen in Table I. Indication indexes are:

- Ind14_1 Infectious stone burden;
- Ind14_2 Unsuccessful ESWL, PNL and URS therapies;
- Ind14_3 Intrarenal anatomical abnormalities;
- Ind14_4 Severe obesity;
- Ind14_5 Non-functioning kidney;
- Ind14_6 Severe skeletal malformations;
- Ind14_7 Arterial aneurysm;
- Ind14_8 Prolapsed kidney.

Contraindication index is :

K₁₄ Blood coagulation problems.

Laparoscopy and open surgery have exactly the same decision trees because all indications and contraindications are the same. Laparoscopy is less invasive so it is always going to have higher priority than the open surgery. In order not to draw exactly the same eight trees, where the only difference is decision nodes (Indications), a decision tree has been drawn

where all eight indications are at the decision node and are indexed with Ind₁₄. The decision tree can be seen in Fig. 4.

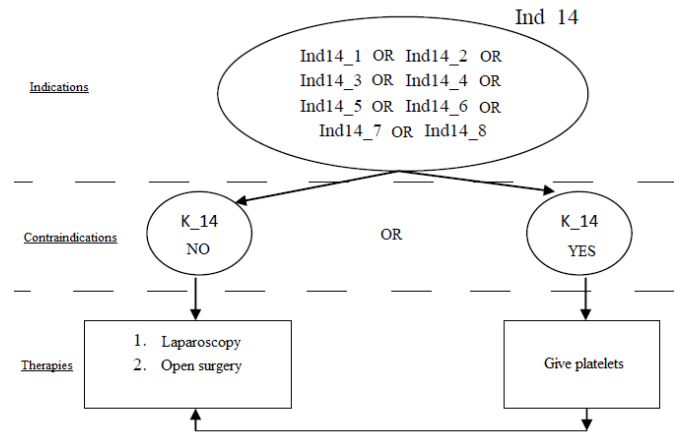


Fig. 4. Laparoscopy and open surgery decision tree.

The production rules are:

- PR 1 **IF** there is Ind₁₄ AND (no K₁₄)
THEN "Use Laparoscopy or Open surgery";
- PR 2 **IF** there is Ind₁₄ AND (yes K₁₄)
THEN "Give platelets" AND "Use Laparoscopy or Open surgery".

III. SOFTWARE AND USER INTERFACE

The software is based on Microsoft Visual Studio, C# programming language. To save patient data and results, FireBird database is used. To manage and modify database IBExpert was used.

It is possible to save all patient data and test results with all selected indications and contraindications that were used during the test process. The database consists of two tables. The patient table and the test result table.

The patient table consists of 10 fields:

PATIENTID	identification number;
FIRSTNAME	name of the patient;
LASTNAME	surname of the patient;
DATEOFBIRTH	date of birth;
SEX	gender;
ADDRESS	address of the patient;
PHONE	telephone number;
EMAIL	e-mail of the patient;
FAMILYDOCTOR	patient's family doctor;
IDNUMBER	personal code of the patient.

This software can be improved with a data sending module, so it is recommended to fill in as many fields as possible. The patient table can be seen in Fig. 5.

#	PK	FK	UNQ	Field Name	Field Type	Domain	Size	Scale	Subtype	Array	Not Null	Charset	Collate
1				PATIENTID	INTEGER		24				<input type="checkbox"/>	UTF8	UTF8
2				FIRSTNAME	VARCHAR		24				<input type="checkbox"/>	UTF8	UTF8
3				LASTNAME	VARCHAR		24				<input type="checkbox"/>	UTF8	UTF8
4				DATEOFBIRTH	TIMESTAMP						<input type="checkbox"/>		
5				SEX	SMALLINT						<input type="checkbox"/>		
6				ADDRESS	VARCHAR		50				<input type="checkbox"/>	UTF8	UTF8
7				PHONE	VARCHAR		15				<input type="checkbox"/>	UTF8	UTF8
8				EMAIL	VARCHAR		50				<input type="checkbox"/>	UTF8	UTF8
9				FAMILYDOCTOR	VARCHAR		50				<input type="checkbox"/>	UTF8	UTF8
10				IDNUMBER	VARCHAR		50				<input type="checkbox"/>	UTF8	UTF8

Fig. 5. Patient table. IBExpert view.

The test result table consists of 6 fields (Fig. 6). All of them are filled automatically during the testing process. The table consists of:

MERJUMIID	identification number of the test;
PATIENDID	identifications number of the patient;
DATETIME	date and time of the test ;
IDIKACIJAS	all indications that are selected;
KONTRINDIKACIJAS	all contraindications that are selected as “YES”;
TERAPIJA	decision on therapy.

#	PK	UNQ	Field Name	Field Type	Domain	Size	Scale	Subtype	Array	Not Null	Charset	Collate
1			MERJUMIID	INTEGER								
2			PATIENDID	INTEGER								
3			DATETIME	TIMESTAMP								
4			IDIKACIJAS	VARCHAR		300					UTF8	UTF8
5			KONTRINDIKACIJAS	VARCHAR		200					UTF8	UTF8
6			TERAPIJA	VARCHAR		50					UTF8	UTF8

Fig. 6. Test result table. IBExpert view.

IV. USER MANUAL

The first window of the software consists of two buttons “Pacienti” and “Tests” (Fig. 7). At the very beginning the new patient must be registered in the database. To do that the doctor must press on the button “Pacienti”.



Fig. 7. Main window.

After pressing on “Pacienti” a new form will appear (Fig. 8). By pressing on the button “Pacientu saraksts”, the doctor can inspect all patients who have already been registered in the database (Fig. 8). This database consists of one patient. By pressing on the button “Jauns pacients” the doctor can register a new patient by filling in the application form. There are two more buttons at the bottom of this form. “OK” will save all data and close this form and return to the main window. “Atcelt” will discard all changes and close active form and return to the main window (Fig. 8).

Fig. 8. Patient's data form.

After returning to the main window (Fig. 7) and pressing on the button “Tests”, a new form will open where the selected patient's history of test results will be shown. As it can be seen in Fig. 9 the patient “Testa Pacients” has got no tests completed yet and all fields are empty. The software has been developed so that the doctor can come back and check the test results any time. If there is at least one test completed for the selected patient, under the label “Veiktie testi”, all tests will be sorted by date and time, and by pressing on one of them the test results will appear under the label “Testa rezultāti”. It is really useful because the doctor can compare older results with the new ones. The button “Jauns tests...” will start a new test, but “Aizvērt” will close this form and return to the main window (Fig. 9).

Fig. 9. Selected patient's test results form.

To start a new test the doctor must press on the button “Jauns tests...”. A new form will open where the doctor must check all patient's identified features that have been diagnosed. When it is done the doctor can press on the button “Tālāk” to go further or “Atcelt” to cancel all and to close the test form (Fig. 10).

Fig. 10. Patient's features form.

When the doctor presses on “Tālāk”, the software will make a decision whether it is a treatment with medication or surgical therapies are needed. In case the patient must be treated by the surgical method, a new form will open where the doctor must check all diagnosed indications (Fig. 11). To go further the doctor must press on the button “Tālāk” or “Atcelt” to discard changes and close this form.

Indikācijas

- ☒ Kaloja akmeņi, kas diametrā mazāki par 20 mm
- ☐ Cistīna akmeņi, kas diametrā mazāki par 20 mm
- ☐ Kaloja akmeņi, kas diametrā lielāki par 20 mm
- ☐ Cistīna akmeņi, kas diametrā lielāki par 20 mm
- ☐ Akmeņu nieru apakšējā daļā, diametrā lielāki par 10 mm
- ☐ Nēdrist pielietot anestēziju un operatīvo iejaukšanos
- ☐ Nesen veikta operācija
- ☐ Infekti akmeņi (infekciozi)
- ☐ Patoloģiska blakusslimība (anērisms)
- ☐ Anomālas nieru iekšējās
- ☐ Patoloģiska aptaukošanās
- ☐ Nefunkcionējoša niere
- ☒ Skeleta deformācijas
- ☐ Pacientam viena niere
- ☐ Noslīdējusi niere
- ☐ Hipertensija
- ☐ Cukura diabēts
- ☐ Bijušas neveiksmīgas ESWL un PNL un URS terapijas
- ☐ Neveiksmīga ESWL un URS
- ☐ Neveiksmīga ESWL terapija
- ☐ Korāļu formas akmeņi
- ☐ Ir radušies urītera traumas
- ☒ Ir izveidojusies sašaurinājums
- ☐ Ir viena niere
- ☐ Ir nieru mazspēja
- ☐ Ir izveidojusies urīna stāze
- ☐ Elpošanas slimības
- ☐ Netrokaloze
- ☐ Nopietna aptaukošanās
- ☐ Akmeņu nierēs un urīnceļā
- ☐ Ir liela atlikušo akmeņu masa

OK Atcēlt

Fig. 11. Indications form.

When all diagnosed indications are checked, the doctor must press on the button “Tālāk”. A new form will open, where the doctor must answer all questions from top to bottom. By default all answers are set to “NO”, because it is the best possible situation when the patient has got no contraindications at all (Fig. 12). When the doctor has answered all questions, the program is ready to make the decision about the treatment which can be obtained by pressing on the button “Slēdziens”.

Kontraindikācijas

Vai ir akūta infekcija.	Jā	Nē
Vai ir audzējs iespējamās piekļuves zonā.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir potenciāls ļaundabīgs nieru audzējs.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir anomālas nieru iekšējās.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir urīna stāze.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir noslīdējusi niere.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir nefunkcionējoša niere.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir skeleta anomālijas.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir bijusi neveiksmīga PNL procedūra.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir patoloģiska blakusslimība (piemēram, anērisms).	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir nopietna aptaukošanās.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir bijusi neveiksmīga ESWL procedūra.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir bēstami dzīvībai, jāpieņem nekavējoties.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vai ir asins recēšanas traucējumi.	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Slēdziens

Fig. 12. Contraindications form.

The Decision about the therapy is given in a new form. All selected indications and contraindications are shown too. The doctor can compare his opinion to the one given by the software. The decision form can be seen in Fig. 13.

Slēdziens

Terapijas:

Jāveikto stents un medikamentozā jārstē infekcija un pēc tās likvidēšanas pielieto kādu no ķirurģiskajām metodēm
Medikamentozā jādod Trombocīti
Izvēle starp laparoskopiju un operatīvo terapiju

Indikācijas:

Kaloja akmeņi, kas diametrā mazāki par 20 mm
Ir izveidojusies sašaurinājums
Skeleta deformācijas

Kontraindikācijas:

Akūta infekcija
Nefunkcionējoša niere
Asins recēšanas traucējumi

OK Atcēlt

Fig. 13. Decision form.

If the doctor presses button “OK” in the decision form, the test results will be saved in the database and the active form will be closed. If the doctor presses on “Atcēlt”, the test results will not be saved and the active window will be closed. Now it is possible to check the history of the selected patient’s test results because they are saved in the database. The selected patient’s test results can be seen in Fig. 14.

Testa Pacients

Veiktie testi

Datums: 01.06.2014. 18:45
01.06.2014. 18:19

Testa rezultāti

Terapijas:

Izvēle starp laparoskopiju un operatīvo terapiju
Jāveikto stents un medikamentozā jārstē infekcija un pēc tās likvidēšanas pielieto kādu no ķirurģiskajām metodēm
Medikamentozā jādod Trombocīti

Indikācijas:

Kaloja akmeņi, kas diametrā mazāki par 20 mm
Ir izveidojusies sašaurinājums

Jauns tests... Aizvērt

Fig. 14. Test results for the selected patient.

V. RESULT AND CONCLUSION

The proposed system allows to perform a quick and efficient testing. It is very flexible and supports different hardware. The software was tested by using real life cases. The attending physician completed this test in real life situations and compared the given decision of therapy with his own decision. The given software was accepted as fully working. There are no fundamental mistakes in the production rule logics because they were confirmed by certified urologist and were signed and stamped.

To create a computerized decision-making by using decision trees and production rules, one of the main tasks was to create synthesis of these two elements. One of the most important stages was knowledge formalization and structuring. Extensive knowledge of the disease development and the patient is needed to choose the optimal therapy. A fully working computer program has been developed and the attending physician can use and test it in practice.

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Martins Krasnovs studied at the Faculty of Computer Science and Information Technology and received his Master degree in Computer Science from Riga Technical University in 2014. Currently he is a PhD student with the Department of Automation and Computer Engineering, Faculty of Computer Science and Information Technology, Riga Technical University. Work experience: Presently he is a programmer–system analyst at TENAX Ltd. and a research assistant with the Faculty of Computer Science and Information Technology, Riga Technical University. Address: Meza Str. 1/3, Riga LV-1048, Latvia. E-mail: martins.krasnovs@rtu.lv

Zigurds Markovics, Dr. habil. sc. ing., Professor (since 1993) with the Institute of Computer Control, Automation and Computer Engineering, Faculty of Computer Science and Information Technology, Riga Technical University.

He is the author of 148 scientific publications and 3 monographs.

His research interests are: computer control systems, artificial intelligence systems, robotics.

He is a Member of Latvian Association of Professors and of Latvian Association of Scientists.

Address: Meza Str. 1/4, Riga, LV-1007, Latvia.

E-mail: Zigurds.Markovics@rtu.lv

Mārtiņš Krasnovs, Zigurds Markovičs. Lēmuma pieņemšanas programmatūras izstrāde nierakmeņu slimniekiem

Darba mērķis ir dator sistēmas izveide, kas ir spējīga pieņemt lēmumu par terapijas izvēli nierakmeņu slimniekam.

Lai datorizētu lēmšanas procesu, nepieciešams veikt vairākus uzdevumus. Terapijas izvēlei nepieciešamas plašas zināšanas gan par slimības attīstību, gan par pašu pacientu. Šajā nozarē eksistējošās zināšanas ir koncentrētas rekomendāciju krājumā, ko sauc par „Vadlīnijām”, kas ir nodrošinātas lēmumu pieņemšanas dator realizācijai. Līdz ar to viens no uzdevumiem ir izveidot terapijas izvēles dator sistēmu uz vadlīnijās apkopotās zināšanu bāzes. Šāda veida zināšanas var strukturizēt, izmantojot lēmšanas kokus, kurus var aprakstīt, izmantojot kādu no zināšanu atspoguļošanas shēmām: produkciju likumi, freimu struktūras, semantiskie tīkli u.c. Šajā darbā produkciju likumi ir izvēlēti par instrumentu lēmšanas koku aprakstīšanai.

Terapijas tiek izskatītas tikai akmeņiem, kas atrodas nierēs. Pēc ķīmiskā sastāva ir iespējams uzstādīt medikamentozu terapiju, kura sīkāk šajā darbā netiek pētīta. Programmatūra ir tendēta uz ķirurģiskās terapijas izvēli, kur katra metode ir izpētīta. Katrai metodei ir indikācijas un kontrindikācijas, kas ir galvenais terapijas izvēlē.

Мартинш Краснов, Зигурдс Маркович. Разработка приложения для принятия решений при почечнокаменных болезнях

Цель работы – разработать приложение, способное принять решение о выборе терапии для больного почечнокаменной болезнью. Чтобы компьютеризировать процесс принятия решений, необходимо выполнить несколько заданий. Для выбора вида терапии необходима информация и о развитии болезни, и о самом пациенте. В данной отрасли знания обобщены в сборнике рекомендаций, называемом «Руководством», и именно оно и пригодно для реализации системы принятия решений. Поэтому одна из задач – создать базу знаний, необходимую компьютерной системе. Таким образом знания можно структуризовать, используя деревья принятия решений, которые можно описать, используя одну из схем отображения и хранения данных: производственные законы, фреймовые структуры, семантические сети итд. В этой работе как инструмент для дерева принятия решений были выбраны производственные законы.

Виды терапии рассматриваются лишь для камней, находящихся в почках. По химическому составу возможно установить медикаментозную терапию, которая более подробно в этой работе не будет рассмотрена. Компьютерная система в основном предлагает хирургическое вмешательство, где каждый из предоставленных методов тщательно исследован и у каждого метода есть свои собственные индикации и контриндикации, являющиеся ключом в выборе вида терапии.