

An Expert System for Diagnosing Dilated Cardiomyopathy

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ABSTRACT: Recent advances in the field of artificial intelligence have led to the design of Medical expert systems. Medical expert systems continue to make progress in key areas for clinical environments.

This work presents the design of an expert system for diagnosis of dilated cardiomyopathy. CLIPS language is used as a tool for designing our expert system. This article presents a rule-based expert system and for this purpose, a decision tree was designed. In order to improve the accuracy of our system, we used Certainty Factor (CF). An evaluation of this system was carried out and positive feedback was received from the users.

KEYWORDS: Expert Systems, CLIPS, heartdisease, dilated cardiomyopathy

I. INTRODUCTION

Nowadays the use of computer technology in the fields of medicine area diagnosis has highly increased. Expert system seeks information from their users in order to make recommendations.

Expert systems are designed to solve complex problems by reasoning about knowledge, represented primarily as IF-THEN rules rather than through conventional procedural code.[1]

MYCIN was the first well known medical expert system developed by Shortliffe at Stanford University to help doctors, prescribe antimicrobial drugs for blood infections [2]. Some of the researchers designed an expert system for diagnosis of coronary artery disease using Myocardial Perfusion Imaging [3]; and, an intelligent medical system for diagnosis of bone diseases [4]. In this work, we will present a design of an expert system for diagnosis of dilated cardiomyopathy using CLIPS.

We present in section II Medical Knowledge, section III CLIPS and expert systems in the medical field, section IV the proposed diagnostic system and decision tree, section V evaluation and section VI Conclusion.

II. MEDICAL KNOWLEDGE

Dilated cardiomyopathy or DCM is a condition in which the heart becomes weakened and enlarged and cannot pump blood efficiently. The decreased heart function can affect other body systems. Dilated cardiomyopathy is the most common form of non-ischemic cardiomyopathy. Patients can experience significant symptoms. These might include:

- breathlessness
- Edema
- angina

Genetic testing can be important. TTN gene (which codes for a protein called titin) are responsible for "approximately 25% of familial cases of idiopathic dilated cardiomyopathy. Generalized enlargement of the heart is seen upon normal chest X-ray. Pleural effusion may also be noticed, which is due to pulmonary venous hypertension. Echocardiogram shows left ventricular dilatation with normal or thinned walls. [5]

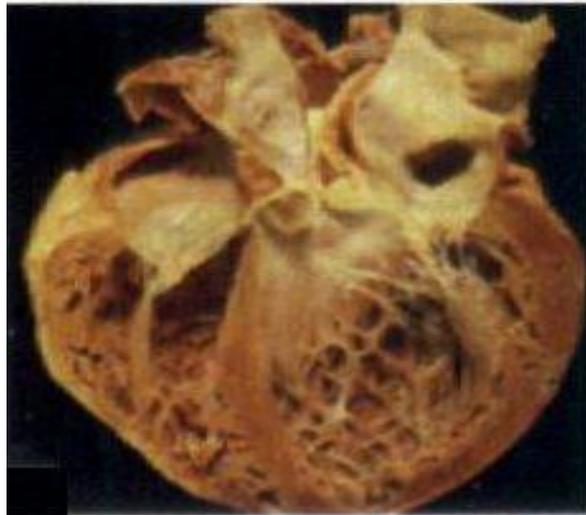


Fig.1.Dilated cardiomyopathy, gross and microscopic appearance [4]

III. CLIPSANDEXPERT SYSTEMSIN THEMEDICAL FIELD

CLIPS is a public domain software tool for building systems. CLIPS, is a forward-chaining, pattern matching knowledge-based system shell. CLIPS stand for C Language Implementation Production System. The procedural programming language provided by CLIPS has features similar to languages such as C. The first versions of CLIPS were developed starting in 1985 at NASA-Johnson Space Center until the mid-1990s. The original name of the project was NASA's AI Language (NAIL).

MYCIN was an early expert system that used artificial intelligence to identify bacteria causing severe infections, such as bacteremia and meningitis

- Explanation System
- Rule Acquisition system

The Mycin system was also used for the diagnosis of blood clotting diseases. It Contains 500 rules and use some form of uncertain reasoning. [6]A specific example of an expert system is PXDES which is pneumoconiosis, a lung disease, X-ray diagnosis. This expert system incorporates the inference engine to examine the shadows on the X-ray. The shadows are used to determine the type and the degree of pneumoconiosis. This system also includes three other modes: the knowledge base, the explanation interface, and the knowledge acquisition modes. [7]DeDombal's Leeds Abdominal Pain System was an expert system for acute abdominal pain. De Dombal's system, developed at Leeds University, was designed to support the diagnosis of acute abdominal pain and, based on analysis, the need for surgery.[7]CASNET (Causal Associational NETWORKS), developed in the 1960s, was a general tool for building expert system for the diagnosis and treatment of diseases. The most significant Expert System application based on CASNET was CASNET/Glaucoma for the diagnosis and treatment of glaucoma.

Expert clinical knowledge was represented in a causal-associational network (CASNET) model for describing disease processes. CASNET/Glaucoma was developed at Rutgers University and implemented in FORTRAN. [7]A rule-based medical expert system for oncology protocol management developed at Stanford University. ONCOCIN was designed to assist physicians with the treatment of cancer patients receiving chemotherapy. ONCOCIN was one of the first DSS which attempted to model decisions and sequencing actions over time, using a customized flowchart language. It extended the skeletal-planning technique to an application area where the history of past events and the duration of actions are important. [7]

IV. THE PROPOSED DIAGNOSTIC SYSTEM

In the present article, the problem of the dilated cardiomyopathy diseases are implemented by methodology of rule based systems. Our expert system contains 46 CLIPS rules. CF is used as numerical value that expresses a degree of belief that a particular fact or rule is true.

Decision tree analysis has long been used when a multi-stage decision process is involved. Figure.1 shows our decision tree.

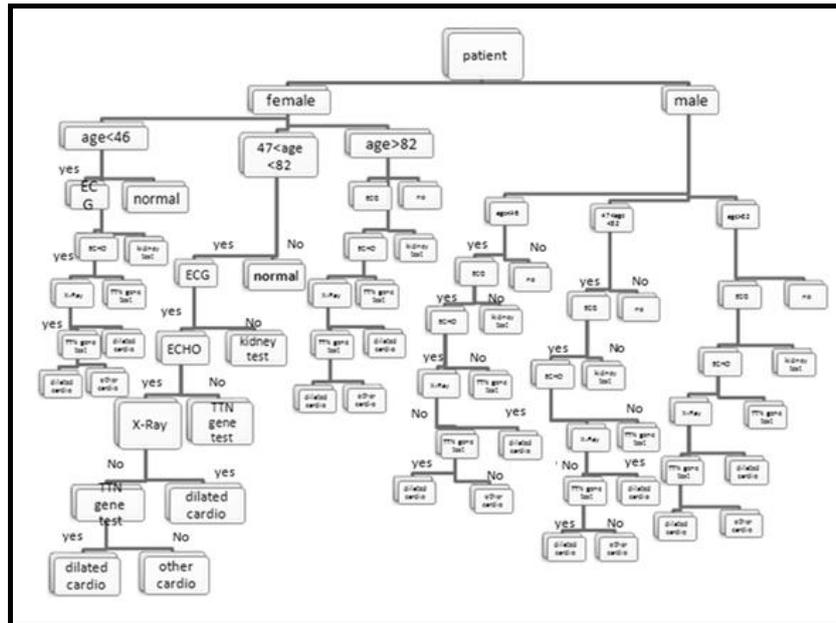


Fig.2 decision tree of our system

Questions that might be asked by our system are as follows:

- 1) Do you have Angina? (Y/n)
- 2) Do you have Dyspnea? (Y/n)
- 3) Do you have edema? (Y/n)
- 4) Enter BNP test result (Pg. /ml)
- 5) Check ECG-result, is any abnormality in T and S waves? (Y/n)
- 6) Is TTN-gene test positive? (Y/n)
- 7) Check Echo result, does it show ventricular arrhythmias, left atrial enlargement? (Y/n)
- 8) Check x-ray result, does it show Pleural effusion? (Y/n)

```
(deftemplate person
(slot sex)
(slot age)
(slot ECG)
(slot Echo)
(slot Xray)
(slot Certainty(default 100.0))

(deffacts initial
  (pahse start))

(defrule prepare-question1
  (pahse start)
=>
  (printout t "-----"crlf )
  (printout t "Do you have Angina (y/n) : " )
  (assert(angina (read))))
```

Fig.3. Types of rules in our expert system

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(defrule r19
  (Sex female)
  (Age? age)
  (BNP? Bnp)
  (ECG? Ecg)
  (Test (<= ?page 46))
  (Test (> ?bnp 140))
  (ECG y)
  (Echo y)
  (Xray y)
  =>
  (printout t " ======" crlf)
  (printout t "          Dilated cardiomyopathy      " crlf)
  (printout t " ======" crlf)
  (halt))
  
```

Fig.4. Types of results in our expert system

Results of the system are shown in Figure5 and Figure 6.

Female	Yes	Yes	Yes	Yes	yes	Yes
BNP-test Abnormalit y	Yes	Yes	Yes	Yes	No	Yes
ECG-test Abnormalit y	Yes	yes	Yes	Yes	-	-
ECHO Abnormalit y	Yes	No	Yes	Yes	-	-
X-Ray Abnormalit y	Yes	-	No	No	-	-
TTN-gene Test result	-	-	Yes	No	-	-
System result	Dilated Cardio myopa thy	Check TTN- Gene	Dilated cardio myopa thy	Suspected to Hypertrophic or Restrictive cardiomyopat hy	No Cardio myopa thy	Suspected to Renal failure(kidney test)

Fig.5. Results of our expert system (Female)

Male	Yes	Yes	Yes	Yes	Yes	yes
BNP-test Abnormalit y	Yes	Yes	Yes	Yes	Yes	No
ECG-test Abnormalit y	Yes	yes	Yes	Yes	-	-
ECHO Abnormalit y	Yes	No	Yes	Yes	-	-
X-Ray Abnormalit y	Yes	-	No	No	-	-
TTN-gene Test result	-	-	Yes	No	-	-
System result	Dilated Cardio myopa thy	Check TTN- Gene	Dilated cardio myopa thy	Suspected to Hypertrophic or Restrictive cardiomyopat hy	Suspected to Renal failure(kidney test)	No Cardiomyo pathy

Fig.6. Results of our expert system (Male)

V. EVALUATION

In order to evaluate our system, its output prescriptions were compared to two other physicians (evaluators) .Comparison between our system and real physicians has proved the accuracy of our system. They are shown in figure7.

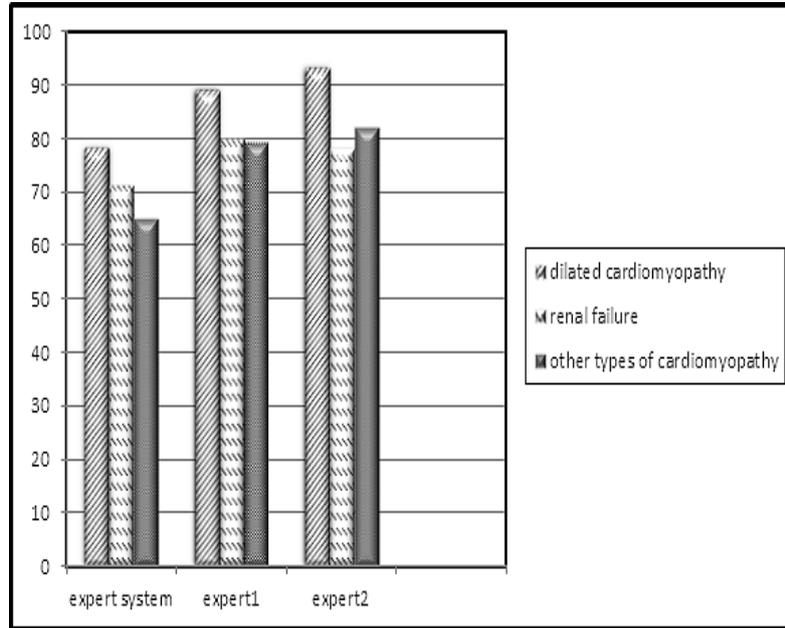


Fig.7. Comparison of outputs with evaluators' opinion

VI. CONCLUSION

The application of expert systems in medicine has created considerable importance systems of diagnosis. The article presented an expert system for medical cases.As future work we will constitute the fuzzy expert system for diagnosis of dilated cardiomyopathy.

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