

# Analysis Of Pulmonary Hydatid Cyst Factors Using Fuzzy Logic System

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**Abstract:** The diagnosis of the hydatid cyst is relatively easy. Medical treatment is often the most recommended. The aim of this study is to evaluate the management of hydatid cyst interventions in our department and to analyze the results of our work. The study concerns 90 cases treated at the level of the surgery department of the university hospital of Setif in Algeria. The study period spans seven years and four months. The study concerned the epidemiological aspect, the clinical aspect and the therapeutic aspect. The hydatid cyst of the lung is an endemic zoonosis in our country. Contact with dogs has been found in almost all of our patients. The lung is most affected after the liver. Although the hydatid cyst of the lung is the most common, it is necessary to look for localization in particular liver. The hydatid cyst of the lung evolves spontaneously towards complications. Surgery is the reference treatment. The results of our interventions are analyzed by a technique of artificial intelligence in particular the principles of the fuzzy inference in view of the complexity and the vagueness of the factors that intervene in the process.

**Keywords:** Hydatid cyst; zoonosis; epidemiology; surgery; fuzzy logic.

## 1. Introduction

Plasma involvement with hydatid cyst is caused by metacestode forms of *E. granulosus* [1]. The prevalence of infection is linked to an abundance of animals, especially dogs in an environment of poor hygiene and lack of pest control. Due to the presence of various hosts, *E. granulosus* is more common than *E. multilocularis* [2]. The hydatid cyst of the lung is often diagnosed after the hydatid cyst of the liver. If medical treatment is advocated, the surgical act is the radical solution to do. In addition to lung cancer, hydatid cysts are the most common parasitic disease. This plague is a public health problem. This applies mainly to the countries of the East, South-East and South America [3]. What characterizes these geographical regions is the contact of their populations with the animals. Adequate preventive management is more than necessary. Our area is also affected by this cyst. The approach taken in our interventions is to determine the size of the cyst from which the decision is made. It should be noted that the hydatid involvement of the lungs can be considered as primary or secondary. Hydatidosis often occurs after damage to the liver. This is distinguished by bronchial fistulization as the stage of cyst evolution. The evolution of the hepatic cyst towards a pulmonary cyst may be caused by rupture of the diaphragm under negative intra-thoracic pressure which sucks the cyst already formed in the liver. In addition to this, negative intra-thoracic pressure tends to suck the hydatid cyst of the liver. In the case of biliary fistula, the caustic property of bile salts [4]. What characterizes these ruptures is that they are often silent from the point of view of clinical symptoms; the danger is that they may constitute a risk of anaphylactic reaction [5]. Whatever the techniques used for medical treatment or aspiration for major lesions, these techniques are frequently used. There are usually difficulties in generating long-term postoperative results and therefore predicting the evolution [6]. The aim of this study was to analyze the results of our interventions and the most frequently reported complications. As the factors are complex and uncertain, we have deemed it

useful to analyze them using a technique of artificial intelligence mainly fuzzy logic analysis techniques. These results make it possible to predict the evolution of the disease before the surgical act and therefore to take the necessary measures before complications.

## 2. Material and methods

The study sample involved 90 cases of patients with pulmonary hydatid cyst. These cases are treated at the level of the surgery department of the university hospital of Setif in Algeria. Of these, 19 were operated for hydatid cyst of the lung. The data for these patients are the age range of 18 to 78 years and the sex of the patients is characterized by male dominance. As a characteristic of these patients, it is their contact with dogs. The hydatid cyst of the lung was symptomatic in the majority of patients. The chest x-ray of the face and profile was the main hydatid cyst of the lung study in our sample. A computed tomography was performed only in the minority of patients. Abdominal ultrasound was performed in all our patients. Conservative surgery has been practiced almost in all our uncomplicated patients. A segmented or lobectomy was performed in the event of a destroyed pulmonary parenchyma. Operational monitoring was favorable with no mortality.

## 3. Disease Factors

Factors that may affect the prevalence of the disease may be summarized as contact with animals, climatic conditions (dry and hot winds may play a role in the respiratory transmission of the parasite), social and economic conditions manifested by the lack of care from the point of view of hygiene and prevention of *E. Granulosus*. The problem is that these factors do not influence the same degree on all patients. Human physiology is very complex. The reaction varies from one person to another, from one sex to another, from one age to another ... etc. As the fuzzy logic deals with uncertainty and imprecision, and viewing the complexity of the system,

we consider that the applications of fuzzy logic principles proves to be adequate.

#### 4. Statistical analysis

Different statistical techniques are used to analyze data related to the risk factors for pulmonary hydatid cyst. Bayesian analysis is used in statistical inference to update estimates of any probability of observations. This requires a thorough knowledge of a situation. Other analyzes use the logistic regression technique to identify factors that characterize a pulmonary hydatid cyst in sick people compared to healthy individuals. This then makes it possible to identify the factors associated with the nature of the cyst. More specifically, logistic regression aims at isolating the effects of each variable in order to identify the residual effects of an explanatory variable on a variable of interest.

great possibility of cyst ". The fuzzy rule base, as well as the classic expert systems, operate on the basis of a knowledge base derived from human expertise.

#### 4.2. Fuzzy Logic Modeling

In our case, the factors involved in the detection of the pulmonary hydatid cyst (Age, sex, climatic conditions, social and economic conditions, contact with domestic animals) are characterized by their imprecision. We can introduce the relationship between a five-inputs and an output system that represent the degree or the the possibility of having a pulmonary hydatid cyst (Figure 1).

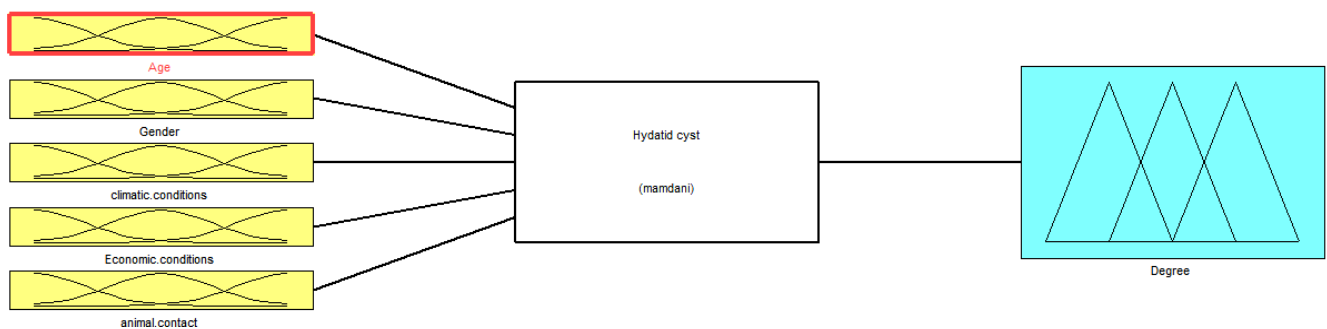


Figure 1: System block diagram

#### 4.3. Fuzzyfication of variables

Each input or output variable must be fuzzy. This operation consists in transforming the numerical data into linguistic variables. The example of the output variable is fuzzyfied into three fuzzy intervals (safe, risky, disease). Fuzzy zones are created between two neighboring membership functions that handle the uncertainties inherent in the nature of the variable (Figure 2).

```
[System]
Name='Hydatid cyst'
Type='mamdani'
Version=2.0
NumInputs=5
```

These two methods remain in the probable; the result obtained is always characterized by uncertainty and is expressed with some inaccuracy

#### 4.1. Inferences rules

A fuzzy implication between two elementary propositions is a relation R between the two sets  $U_1$  and  $U_2$ , quantifying the degree of truth of the proposition:

$$\text{If } (x \text{ is } A) \text{ than } (y \text{ is } B)$$

Where, A and B are subsets of  $U_1$  and  $U_2$  respectively. We call inference rules the set of different rules linking the fuzzy input variables of a system to the fuzzy variables of output of this system. They must be defined by the detection system designer according to their experience. A rule is of the type: IF "predicate" THEN "conclusion" "IF economic conditions are low AND environmental hygiene is unhealthy THEN

```
OrMethod='max'
ImpMethod='min'
AggMethod='max'
DefuzzMethod='centroid'
```

```
[Input1]
Name='Age'
Range=[0 100]
NumMFs=3
MF1='young': 'trimf',[0 20 40]
MF2='adult': 'trimf',[30 45 60]
MF3='old': 'trimf',[50 75 100]
```

```
[Input2]
Name='Gender'
Range=[0 3]
NumMFs=2
MF1='male': 'trimf',[1 1 1]
MF2='female': 'trimf',[2 2 2]
```

```
[Input3]
Name='climatic.conditions'
Range=[0 4]
NumMFs=3
MF1='low': 'trimf',[0 1 2]
MF2='average': 'trimf',[1 2 3]
MF3='high': 'trimf',[2 3 4]
```

```
[Input4]
Name='Economic.conditions'
Range=[0 4]
NumMFs=3
```

### 5.Result and discussion

Some studies report that more women are more affected than men by the disease [7]. This is because women are more responsible for animal care and home food preparation than men in these areas. Other studies show that there is no relationship between sexes, but it all depends on who cares for domestic animals [8]. In our case, the medical treatment concerned at virtually all ages. Also both sexes are concerned while male dominance is reported. Interventions on the hydatid cyst of the lung were symptomatic in the majority of patients. Operational monitoring was carried out in accordance with due process and the outcome was favorable. Adequate management has resulted in a zero mortality rate. The epidemiological investigation revealed the contact of these patients with domestic animals and come from an average socio-economic environment. After reading these variables, the analysis by fuzzy logic made it possible to establish a database linking the factors of appearance of the pulmonary hydatid cyst with the number of cases treated in our surgical department. We have carried out the establishment of thoracic imaging which is necessary as stipulated in the literature in the case of a positive diagnosis of the hydatid cyst ruptured in the pleura [9]. In order to refine the diagnosis, we also followed the protocol of

establishing an ultrasound as an examination after chest X-ray. For when a residual cavity with or without a hydatid membrane or evocative opacity is associated with the healthy homo or contralateral cyst, this increases the diagnosis [10], [11].

```
MF1='poor': 'trimf',[0 1 2]
MF2='middle': 'trimf',[1 2 3]
MF3='rich': 'trimf',[2 3 4]

[Input5]
Name='animal.contact'
Range=[0 4]
NumMFs=3
MF1='no.contact': 'trimf',[0 1 2]
MF2='medium': 'trimf',[1 2 3]
MF3='big.contact': 'trimf',[2 3 4]

[Output1]
Name='Degree'
Range=[0 4]
NumMFs=3
MF1='safe': 'trimf',[0 1 2]
MF2='risky': 'trimf',[1 2 3]
MF3='disease': 'trimf',[2 3 4]
```

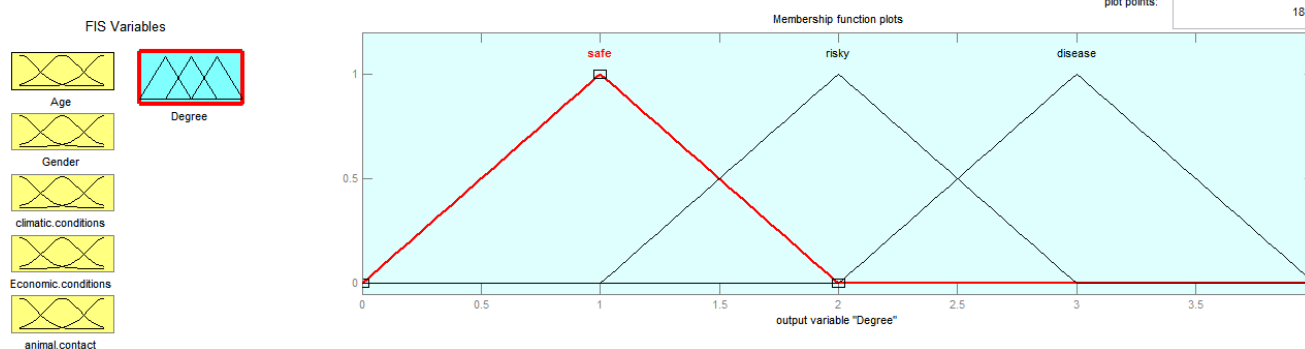
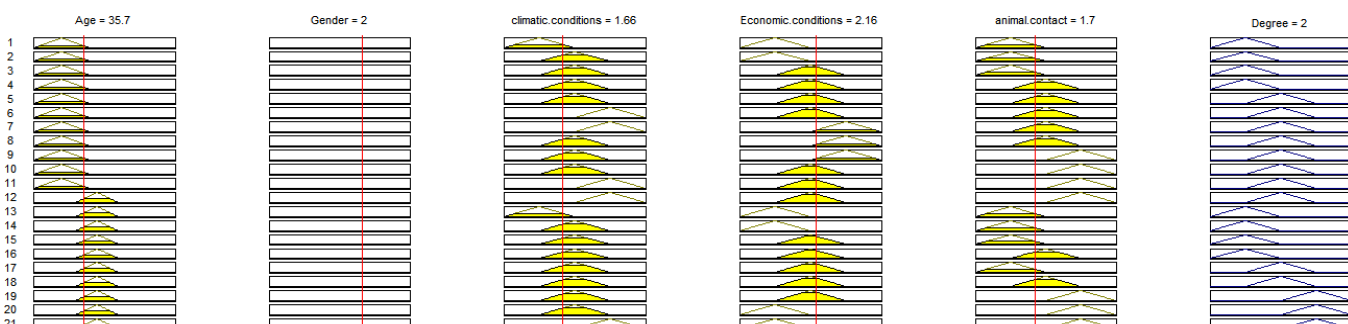


Figure 2: Fuzzyfication of output variable

Before the surgical procedure, medical treatments were tried, especially based on albendazole, but surgery remains the best choice, as reported studies [12]. The surgery practiced in the hydatid cysts is the total excision in the majority of our interventions; Lobectomy was performed in cases where more than half of the lobe was involved, the best solution in agreement with the solutions being recommended in different cases of these cases. [13]. In the case of simple hydatid cysts, the best treatment remains the enucleation with the padding according to the conclusions of other surgeons [14]. In order to prevent these heavy surgical treatments, we analyzed the data relating to these patients in terms of risk factors. The risk factors taken into account are: age, sex, climatic conditions, socio-economic level and degree of contact with animals. These factors are considered input parameters of the system. As the process is far from accurate, given the

complexity of the process, we considered them as fuzzy variables and therefore uncertain. For this, a fuzzyfication of each parameter is performed. The output variable is expressed as the degree of involvement with probable pulmonary hydatid cyst. This variable is also fuzzyfied to compensate for uncertainty and imprecision. By establishing a basis of the rules of the form (If ... Then), from the real data relating to these patients, the system allows to randomly input values to instantly read the possibility of a person reaching by the pulmonary hydatid cyst (figure 3).



## Conclusion

Hydatid cyst of the lung requires rigorous prevention at all levels of the epidemiological chain in order to reduce the parasitic cycle, which requires close cooperation between the medical, veterinary and agricultural sectors. Our patients were treated as a preventive measure before arriving at the surgical procedure. Despite the fact that surgery remains the reference treatment, complications are more frequent and pose a problem of definition and complexity of management. Despite the success of all our surgical procedures with proper management and a 100% success rate, we advocate prevention so as not to reach the disease in the first place. To this end, the proposed system makes it possible to analyze the factors relating to this disease. Since the system is very complex, the varieties are imprecise and uncertain; the application of the principles of fuzzy inference is adequate. This technique compensates for failures related to mathematical analysis. Because the statistical tool often used in data analysis does not support these uncertainties and the effect of other factors that have their effects and are totally ignored. This tool can be a means of prevention and foresight of this disease. Despite this, we encourage early diagnosis to minimize the risk of fatal complications.

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