Differential diagnostic algorithm for diseases manifested by chest pain syndrome

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Abstract

Background A chest pain stipulates great clinical, methodological, economic, social, psychological problems. There are dozens diseases of various organs manifested by chest pain. Diagnostic errors happen often. Suggested Differential Diagnostic Algorithm (DDA) is a certain universal intellectual tool, which could facilitate the chest pain problems solving.
Objective The Chest Pain (CP) DDA creation for effective differential diagnostics of diseases accompanied with chest pain for use primarily in a polyclinic, ambulance, ED.
Methods Presented here new CP DDA is developed by the author for the chest pain syndrome as the original intellectual method of clinical thinking based on the problem-oriented algorithmic approach.
Results The retrospective posthumous study of 127 case records of patients who died of a fatal heart attack was performed too. The errors of the retrospective algorithmic diagnoses based on the symptoms/signs written down in 127 case records were in ~4 times less, than at the collective posthumous clinical diagnosis, in 6,3 times less errors than life-time diagnoses in cardiological clinics, and ~9 times less than antemortem diagnoses in the admission department. The main result is the new chest pain DDA presentation. Conclusions By means of presented DDA every physician and medical student can diagnose successfully of 48 diseases manifested by chest pain.

INTRODUCTION

It is well known great problems of the chest pain syndrome:

1) A chest pain syndrome spreading worldwide [1-3]

2) Dozens of various diseases of different systems, accompanied by acute chest pain [4-5]

3) Numerous diagnostic errors, in particular, in cardiology, and especially fatal errors at acute myocardial infarction (AMI) [6-14]

4) Superfluous examinations during a process of diagnostics [15-18]

5) High cost of reliable diagnosis [19-22]

6) Short time of differential diagnostics that frequently should be carried out in extreme conditions and at the limited methodical arsenal [23]

Last years 1500 CPC were established in the USA[24-26]. A concentration of the best professionals and methodological sources in large CPC is an effective idea. However, CP patients are encountered everywhere, but establishing such centers everywhere is impossible. Therefore, it is very important to find a non-standard approach and methodology that can improve diagnostic results with CP patients significantly, be widely used and also be economical and more efficient. The best achievements in optimal diagnostics must be accessible for remote citizens.

In modern medical practice there is no a common working tool, which could solve above mentioned problems at the bottom steps of public health services quickly and cheaply. A DDA can become such universal tool. Our previous experience has revealed the outcomes that many times better than traditional diagnostics [27-30].

MATERIALS AND METHODS

The comparative evaluation of traditional and algorithmic diagnostics of AMI has been performed in the former USSR. The previous DDA for chest pain syndrome was elaborated under management and at participation of the author. The author has interpreted retrospectively with the DDA each s/s written down in 127 case records of the patients, who died

from the AMI. The new CP DDA presented below has been development by the author.

STATISTICAL METHOD

The proportions of confirmed conclusions from concurrent diagnostic methods were analyzed by Chi-square tests. The Pearson test has been used and p-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

It is known, that the most reliable diagnosis – is pathologoanatomic one. The retrospective comparative evaluation of the diagnoses established in the case records of died patients, and interpretation of s/s, written down in the same case records by means of the DDA's represents special interest (Tables 1-3). Reliability of the pathologoanatomic diagnosis is 100%. All other diagnoses were compared with these ones. A clinical final posthumous diagnosis was carried out collectively at the presence of all scientists and physicians of faculty and hospital before immediate autopsy.

The purpose of this stage of diagnostics always was to write down in the case record a maximum of the more probable diagnoses for minimizing divergences of the given posthumous clinical diagnosis with the pathologoanatomic conclusion. The results are presented in the Tables 1-3.

Figure 1

Table 1. Retrospective comparative evaluation of traditional and algorithmic diagnosis of AMI in the light of pathologoanatomic diagnosis (127 cases)

	Correct diagnosis	Erroneous diagnosis
Diagnostics of AMI		
Pathologoanatomic diagnosis	**127**	0
Clinical final posthumous diagnosis	**116**	**11**
Diagnosis with DDA	**124**	**3**

p-value = 0.0278.

The errors of the algorithmic diagnoses based on the s/s written down in case records are in ~4 times less, than at the collective posthumous clinical diagnosis (Table 2.1.).

Figure 2

Table 2. Retrospective comparative evaluation of traditional and algorithmic diagnosis of AMI in the cardiological clinics (127 cases)

Diagnostics of AMI	Correct diagnosis	Erroneous diagnosis
Clinical diagnosis in cardiological clinics	**89**	**38**
Diagnosis with the DDA	**121**	**6**

p-value<0.001

The Tables 2-3 shows that algorithmic diagnostics provides in 6,3 times less errors than diagnoses in cardiological clinics, and ~9 times less than diagnoses in the admission department.

Figure 3

Table 3. Retrospective comparative evaluation of traditional and algorithmic diagnosis of AMI in the admission department (127 cases)

Diagnostics of AMI	Correct diagnosis	Erroneous diagnosis
Diagnosis in the admission department	**74**	**53**
Diagnosis with the DDA	**121**	**6**

p-value<0.0001

There are important not only these results. The algorithmic diagnoses were established on the written down s/s, fixed in the case records at a life but not be interpreted correctly in one's lifetime at all stages of diagnostics. For example, in one case record of died patient 7 diagnoses were fixed. However, 16 diagnoses established with algorithms using already s/s written in the same case record.

In other case record algorithmic diagnosis of the AMI was established on the one sign. But this sign did not interpreted diagnostically in the clinics at the time of revealing and written. The diagnosis of the AMI was established and written down in the clinics only in 46 hours after in the given record, when fatal complication of the heart attack has appeared.

So, diagnostics by means of our algorithms is very close to pathologoanatomic diagnoses. I have especially emphasize «our algorithms», because the term «diagnostic algorithm» has received a huge distribution in the literature, e.g. over 4,000,000 publications presented with this term in the titles in the Internet in 2008. But many publications does not correspond to the concept «diagnostic algorithm» usually, have not obligatory properties, and do not provide those results, which are achieved by means of veritable diagnostic

algorithm as in the Tables 1-3.

Diseases, manifested with chest pain included in the Differential Diagnostic Algorithm

Figure 4

Cardiovascular diseases
1. Acute myocardial infarction
2. Aortic dissection
3. Stable angina pectoris
4. Unstable angina pectoris
5. Crescendo angina
6. Angina variant (Prinzmetal's)
7. Acute nonsuppurative pericarditis
8. Acute suppurative pericarditis
9. Cardiac tamponade
10. Aortic valvular stenosis
11. Cardiomyopathy secondary
12. Patent ductus arteriosus with right to left shunt
13. Mitral valve prolapse
14. Hypertrophic subaortic stenosis

Pulmonary and pleural diseases
15. Acute massive pulmonary embolism
16. Pulmonary thromboembolism
17. Pulmonary infarction
18. Staphylococcal pneumonia
19. Pneumococcal pneumonia
20. Klebsiella pneumonia
21. Pneumothorax
22. Primary pulmonary hypertension
23. Secondary pulmonary hypertension
24. Pulmonary abscess
25. Atelectasis
26. Bronchial adenocarcinoma
27. Bronchogenic carcinoma squamous cell type
28. Empyema
29. Pleural malignant mesothelioma
30. Thoracic actinomycosis

Abdominal diseases
31. Carcinoma of esophagus
32. Diffuse esophageal spasm
33. Reflux esophagitis
34. Subphrenic abscess
35. Acute pancreatitis
36. Irritable bowel syndrome

Musculoskeletal diseases
37. Myalgia
38. Cervical osteochondrosis
39. Intercostal neuralgia
40. Tietze's syndrome
41. Traumatic rib fracture
42. Pathological rib fracture
43. Traumatic pneumothorax
44. Traumatic hemothorax

Miscellaneous diseases
45. Herpes zoster
46. Familial Mediterranean fever
47. Cystic fibrosis (adult form)
48. Anxiety neurosis

The abbreviations of the methods that are written under established diagnoses in the below-mentioned DDA have the following sense.

DE – Decisive examination;

EC – Echocardiography;

AC – Angiocadiography ;

PA – Pulmonary arteriography;

AG - Aortography;

HC - Heart catheterization.

US – Ultrasound of abdomen

If a doctor considers, that the diagnosis in algorithm must be the most precise, he can apply last the most reliable, but also more expensive often invasive examination. If under of the algorithmic diagnosis such abbreviation is not presented, the given last algorithmical diagnosis just is the most reliable.

The creation of the DDA structure is variable. In the beginning of the algorithm generalizing groups of diagnoses are presented. The criterion of division to different groups is a presence or absence of dividing s/s on each step of the DDA. In the beginning the DDA can divide by one common s/s all diseases with given syndrome to two big groups. At the subsequent stages of diagnostics the DDA is divides of each group up to a final diagnosis of every separate disease by means of several consecutive s/s. However, the algorithmic diagnostic thinking can be organize more detailed, if it is more important strategically to diagnose first of all the most dangerous diseases during several minutes or even seconds.

Such second structure allows to diagnose step by step the most valuable but clinically popular s/s of the most dangerous diseases and to accept emergency measures of rescue. After that the DDA divides of similar diseases on groups up to every final diagnosis. In this article the second variant of the DDA is presented.

Fundamental identifying characteristic of the DDA

The veritable DDA has the following main features:

1) Definiteness, i.e. simplicity and unambiguous of intellectual operations stage-by-stage.

2) Mass character, i.e. given DDA should be applicable to all diseases manifesting by given leading syndrome.

3) Efficiency, i.e. obligatory establishing of the diagnoses of all diseases, for which the given algorithm is designed (under the condition of correct recognizing of s/s contained in the DDA).

4) Discontinuity, i.e. a partition of process of diagnostic thinking on elementary clear intellectual diagnostic operations located in optimal sequence

Any structures named as “algorithm”, but inadequate to these four properties of paramount importance, are not

veritable algorithms, but pseudo algorithms.

OBJECTIVES OF THE DDA FOR A CHEST PAIN SYNDROME

1. Rapid and efficient diagnostics of diseases accompanied by acute chest pain, using new optimal intellectual diagnostic decision approach.

2. Fast comprehensive differential diagnostics and reliable final diagnosis of diseases manifested by acute chest pain.

3. Help a doctor in ED to determine the admission or discharge of primary patients with a chest pain.

4. Minimizing diagnostic costs.

PRACTICAL USE OF THE CP DDA

For practical use of the CP DDA it is necessary to print the text of the DDA below on a paper. The sheets with the text of the CP DDA must be on a physician's table right in front of his eyes. Every patient with complaints to a chest pain must be examined step by step in strict conformity and sequence of each of s/s of the DDA while corresponding s/s will not lead to the suitable diagnosis. All diagnoses are underlined.

The first three diagnoses of the DDA are fatally dangerous, and demand the corresponding emergency help. It is necessary to transport of the patient to a nearest ED urgently.

The majority of algorithmic diagnoses does not demand immediate precise confirmation by the most reliable methods of examination, mentioned under the diagnoses and designated as DE – decisive examinations. These additional examinations can be appointed in special cases, e.g. if a surgical intervention is planned.

In given CP DDA all diagnoses will be established by 2 – 9 s/s. 17 final diagnoses are established on the 2^{nd}-4^{th} steps, and 15 diagnoses on the 6^{th}-7^{th} steps of the CP DDA. The whole intellectual process of differential diagnostics of the CP causes occupies a few minutes.

At each stage of thinking, whole branches of the CP DDA are cut off, depending on available s/s of the patient. But each of the branching DDA provides several diagnoses. Therefore, differential diagnostics of all of 48 diagnoses by means of the CP DDA is never carried out. Those diagnoses are divided only, which have the common s/s at the first top stages of the algorithm and on each following step.

The DDA presented below is not necessary to learn by heart. For generating at itself a syndromic algorithmic thinking confidently and quickly, it is necessary to train in the decision of diagnostic tasks by means of the DDA. These tasks should cover all branches of the algorithm and establish of all diagnoses included in the DDA.

Diagnostic tasks for faster mastering of the work with the CP DDA are facilitating, and accelerate a subsequent work with real patients. For this purpose it is necessary to insert the s/s, which provides a given diagnosis in the DDA into the list of the s/s of each task. In addition it is useful to rewrite some s/s of each disease that is presented in the DDA from any textbook or Internet. In such tasks not algorithmic s/s play a role of "informational noise". Sense of training with diagnostic tasks is in that among many s/s to find those s/s which conducts to diagnoses in the DDA quickly.

Consecutive prescriptions of the DDA have been presented here as a continuous tape. For algorithmic work with patients the optimal variant is to print out and to paste together the pages with the DDA. Then the whole DDA will be on a doctor's table.

My huge experience shows, that the effective clinical thinking is formed very quickly. And the faster, than it is more various tasks of the given syndrome will be solved with the given algorithm. Doctors and students will be surprised with that in some days of a work with patients by means of the DDA they will diagnose the diseases which have caused of a chest pain, already freely, not looking in the text of the algorithm. An imprinting of the algorithm occurs into a brain of the person using of the DDA for practical activity.

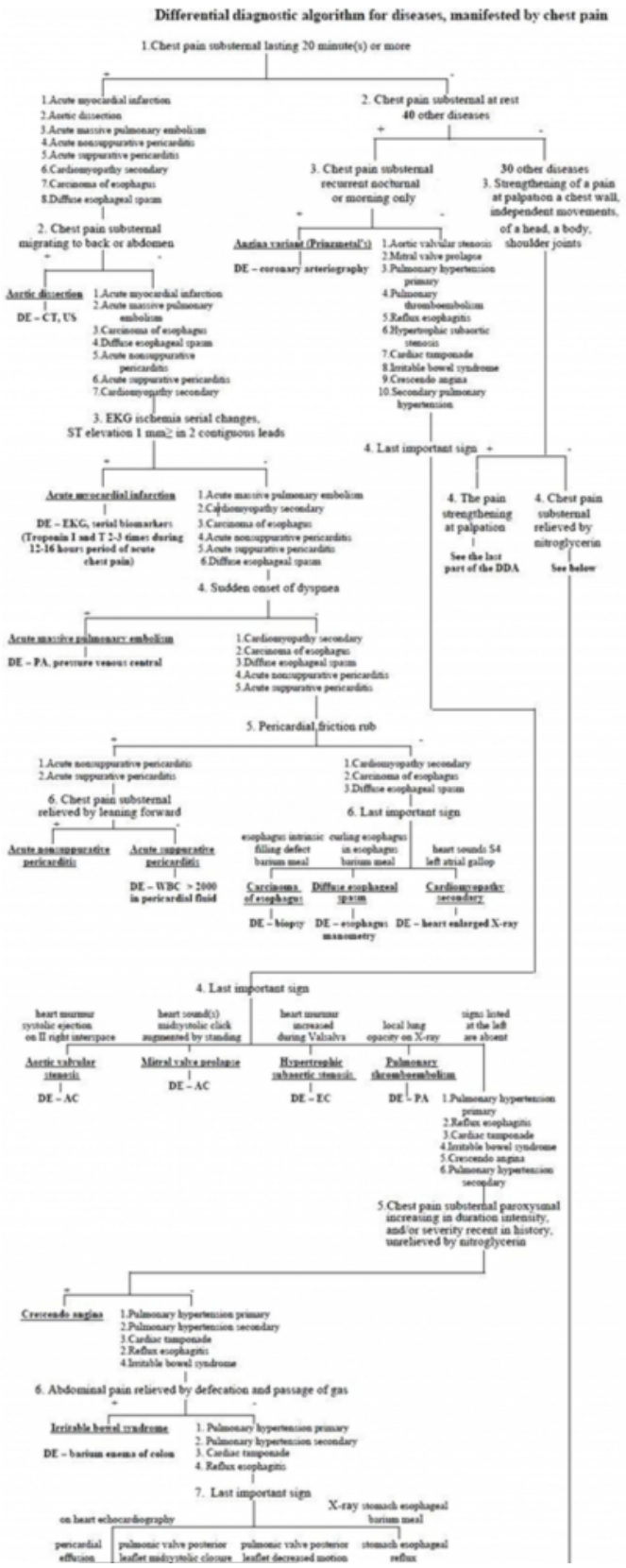
Efficiency of the given Chest Pain Differential Diagnostics Algorithm is determines by the following. 48 diagnoses of the diseases manifested by the chest pain syndrome are established with the DDA. This final result is achieved by means of all 53 s/s. But it is the most valuable dividing s/s. Moreover, up to the latest stages of differential diagnostics these are the s/s revealed under complaints, history, and the simple examinations accessible in anyone polyclinics, ambulance, and ED.

And only at the last important sign diagnostics special diagnostic methods are apply. E.g. chest plain radiography - 12 times, abdominal radiography - 3 times, sputum culture - 6 times, heart echocardiography - 2 times, blood analysis - 1 time.

It is easily to determine of the DDA efficiency, taking into account how many pages in any textbook the description of 48 diseases occupies. And if to recollect, that reading of these huge number of pages not always provide correct diagnoses.

Though we publish the book with the algorithms in whole cardiology in the USSR (29), the author's DDA presented here is completely original, fundamentally differs from former author's algorithms. This DDA is based on gold standard symptoms/signs and methods of modern western medicine.

Figure 5



CONCLUSIONS

The strategic principle of the veritable Differential

Diagnostic Algorithm is “To spend a minimum for receiving of a maximum”.

The veritable CP DDA allows the following problems solving at the bottom steps of health care and medical practice.

1. Diagnostic problems solution. The CP DDA is based on the innovative intellectual approach to medical diagnostic decision-making. The CP DDA provides the differential diagnostics of all or majority diseases within the framework of the whole chest pain syndrome during the shortest time, using minimum accessible examinations and decisive s/s. The CP DDA decreases of diagnostic errors many times in comparison with traditional diagnostics. The CP DDA radically reduces of a cost of diagnosis. CP DDA forms optimal effective mind, clinical decision making, in particular.

2. Training problems of medical education solution. Unlike of traditional training based on descriptive nosological principle of thinking, the CP DDA use the minimum of the most effective methodologies formative the optimal syndromic algorithmic diagnostic decision-making. A preliminary decision of diagnostic tasks by means of the CP DDA considerably facilitates and accelerates a work with patients. The mastering of the most effective algorithmic thinking is occurs very quickly, and during a short time becomes the physician’s independent effective clinical thinking. In fact the imprinting of algorithmic thinking into the physician’s brain takes place.

3. Economical problems solution. Minimum medical examinations and decisive s/s in the DDA ensures many times cheaper final reliable diagnoses.

4. Psychological problems solution. The CP DDA offers the skilled diagnostic intellectual activity and the best outcomes to practician by the self-training mode. A high motivation of learners forms a psychological encouragement during work with the DDA.

5. The wide spreading of veritable CP DDA can be easily provided via Internet/Intranet technologies most comfortable for users’ to concentrate on their intellectual self-training work for the best professional diagnostic activity.

Diagnostic algorithms are not panacea. Cases of various illnesses with unclear s/s are well-known, including an asymptomatic AMI with negative EKG data. If a patient has not clear s/s of a disease, the algorithm will not help to establish a diagnosis. Nevertheless clinical diagnostics is bases on the available and correctly finding s/s of disease. In these cases veritable diagnostic algorithms are the fine working tool for diagnostics of illnesses optimization.

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