

***Corresponding author**

Saifutdinov R.G, KSMA – Brunch Campus of the FSBEI FPE RMACPE MOH Russia, 36 Butlerova st, Kazan, 420012, Russia.
Email: rgsbancorp@mail.ru

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***List of Abbreviation**

ALT: alanine aminotransferase
AST: aspartate aminotransferase
APTT: Activated Partial Thromboplastin Time
BBT: Biochemical blood test
CPE: Continuing professional education
ECG: Electrocardiogram
ECTS: European Credit Transfer and Accumulation System
ESR: Erythrocyte sedimentation rate
GBT: General blood test
INR: international normalized ratio
MRI: Magnetic resonance imaging
RES: Rate of erythrocyte sedimentation

**Postgraduate Medical Training is an Important
Milestone in Achieving the Success of Healing**

Saifutdinov R.G, Yusupova N.Z, Ratner F.L, Mitusheva E.I, Mayorova E.M, Gabitov S.Z, Saifutdinov R.R, Mukhamadiev R.R, Salyakhova E.V

KSMA – Brunch Campus of the FSBEI FPE RMACPE MOH Russia, 36 Butlerova st, Kazan, 420012, Russia.

Abstract

Postgraduate medical education plays a key role in improving the quality of medical care, introducing new methods of diagnosis and treatment, and improving clinical outcomes. This article discusses the importance of continuous professional development for doctors and analyzes various forms and methods of training. It presents the concept of clinical thinking and the stages of establishing institutions for the improvement of doctors in Russia. The article also presents a clinical case of primary hyperaldosteronism (Conn's syndrome) in a woman. The article analyzes the disadvantages of late diagnosis of the disease.

Relevance

Progress in medicine and people's increased attention to their health require a constant high professional level of doctors. Modern medicine is developing rapidly: new diagnostic methods, medicines and surgical technologies are emerging. A doctor who graduated from a higher educational institution 10-20 years ago, without constant updating of knowledge, risks lagging behind progress, which can lead to errors in diagnosis and treatment. Postgraduate studies are not just a formality, but a necessary condition for maintaining professional competence.

Aim: to analyze the role of clinical thinking in the development of professional competencies of doctors.

Methods

- Analysis of scientific publications on medical education (Scopus, PubMed, eLibrary).
- Comparison of educational models in Russia and abroad.
- Presentation of a clinical case.

Results

According to the recommendations of the World Health Organization, continuing medical education should be mandatory for all doctors [19]. Studies show that doctors who receive regular training are:

- 32% less likely to make diagnostic errors [20];
- Modern clinical guidelines are applied 25% more effectively [21];
- Increase patient satisfaction by 18% [22];
- Increase the survival rate of patients with chronic diseases [23].

For example, the introduction of modern cardiology courses in Russian regions has led to a 12% reduction in heart attack mortality over 5 years [24].

Currently, the following training formats are used in medical education:

- Full-time professional development cycles (traditional form);

- Distance learning (webinars, online courses) allows doctors from remote regions to gain knowledge from leading specialists;
- Simulation training – improves practical skills without risk for patients [25];
- Analysis of clinical cases, analysis of mortality and clinical conferences – helps to analyze errors and prevent their recurrence [26].

Abroad, the Bologna Credit and Accumulation system is mainly used. It is implemented through the use of the system of educational credit units (ECTS) [9]. At the same time, the accreditation and certification of a specialist is confirmed every 5 years and 1 credit is equivalent to 1 hour of educational activity. As a result of the accumulation of the required points, the final exam is not required. ECTS evaluates the specific weight of educational activities and enables the doctor to form his own individual program of continuous professional development [17, 16, 18].

To date, there are no institutions abroad similar to state institutes for the improvement of doctors. Until now, there have not been established complete, in their full understanding, the functions and purpose of specialized medical institutions for the improvement of doctors. Doctors practice in clinics and medical schools.

In Russia, the established system of continuing medical education is the most acceptable and efficient. In Russia, the established system of continuing medical education is the most acceptable and efficient. After receiving higher education, graduates have the opportunity to work as a doctor in their primary specialty. Further training is conducted in a residency program, at professional retraining and advanced training courses in institutions of higher medical education, or in institutions of additional professional education. Institutions of additional professional education were previously called state institutes for advanced medical training.

The first institution in the world, established in 1885 specifically to improve the skills of doctors, was the Eleninsky Clinical Institute in St. Petersburg. This idea was proposed by N.I. Pirogov, N.F. Zdekauer and E.E. Eichwald. The latter, back in the 70s, developed his project [1, 2, 5]. Grand Duchess Elena Pavlovna played a major role in bringing this idea to life. She secured the allocation of a plot of land for him on the parade ground of the Preobrazhensky regiment and bequeathed 75,000 rubles from her personal funds. for the construction of this institute [13].

Professor E.E. Eichwald (Head of the Department of Therapy) was appointed the first director of the Institute. Initially, a therapeutic and surgical clinic with 80 beds, an outpatient

department and a pharmacy were opened. The Department of Surgery was headed by Professor N.D. Monastyrsky [10].

The stages of the creation of state institutes for the improvement of doctors: the Clinical Institute of Grand Duchess Elena Pavlovna (1885), the Kazan State Institute for the Improvement of Doctors (1920), the Central Order of Lenin Institute for the Improvement of Doctors (Russian Medical Academy of Postgraduate Education) (1930) Moscow, then one each in fifteen Soviet Socialist Republics [3, 4, 6, 14]. Currently, the largest medical institution in the system of continuing professional education is the Russian Medical Academy of Continuing Professional Education (Moscow) and its branches: Kazan, Irkutsk, Novokuznetsk and Penza [11].

What is the difference between vocational training institutions and medical institutes, academies and universities? How do they attract doctors?

The main task of vocational training institutions is to teach doctors clinical thinking. Students at universities are taught fundamental theoretical knowledge (anatomy, physiology, clinical biochemistry, pathophysiology, genetics, etc.). CPE institutions should teach the ability to heal, make a quick diagnosis, compare laboratory and instrumental data with complaints, symptoms and the clinical picture of the patient, think through logical treatment and rehabilitation, discuss disease prevention with the patient.

Clinical thinking is a doctor's creative, professional approach to diagnosis, treatment, and prognosis of the course of a disease. It is based on the knowledge, intuition and experience of a doctor. Its formation is a long path of self-knowledge and improvement, leading to high professionalism [12, 15, 11].

Clinically minded doctors make 30-40% fewer diagnostic errors (Graber et al., 2018).

Methods of clinical thinking formation in postgraduate education:

1. **Analysis of clinical cases:** It allows doctors to analyze real-world situations and make decisions in conditions of uncertainty. According to Gromov [26], this method increases diagnostic accuracy by 25%.
2. **Simulation training:** The use of virtual patients and high-tech simulators. McGaghie [25] has proven that simulations improve clinical skills and decision-making speed.
3. **Problem-oriented learning:** Builds the skills of independent search for solutions. According to research by the Ministry of Health of the Russian Federation (2023), the introduction of problem-based learning reduces the time for diagnosis by 15-20%.

4. Supervision and mentoring: Working with experienced mentors helps young doctors avoid cognitive errors.

It is impossible to develop clinical thinking with the help of textbooks, no matter how wonderful such guidance may be.

You can learn clinical thinking only by practicing under the supervision of a teacher with extensive clinical experience. There was and still is a tradition of teaching at the bedside of the patient in the institutions of vocational education and training. The cycles of professional retraining and advanced training necessarily include analysis of real clinical cases. The opportunity to see how a recognized expert in his field reasons and makes decisions is invaluable for shaping his own style of clinical thinking.

In accordance with the above, it makes sense to give an example of insufficient clinical thinking in therapeutic practice.

An example of insufficient clinical thinking

On 12.01.2022, a 45-year-old patient K. was admitted to one of the basic hospitals of the Kazan State Medical Academy, a branch of the Federal State Budgetary Educational Institution of Higher Professional Education of the Russian Ministry of Health, complaining of general weakness, headache, numbness and weakness in her arms and legs, and an increase in systolic blood pressure to 180/100 mm Hg.

According to the complaints in the emergency room, one might have thought about hypertension. However, this diagnosis did not include numbness and weakness in the arms and legs, as a neurologist's examination revealed no brain abnormalities.

Anamnesis morbi: He has been suffering from elevated blood pressure since 2010. Then he was diagnosed with hypertension. In May 2014, a decrease in potassium (K⁺) (3.2 mmol/l) was accidentally detected in the blood. In December 2020, in preparation for surgery on a curved nasal septum, K⁺ in the blood was reduced to 2.3 mmol/l. Potassium and magnesium preparations were prescribed. At this time, the patient began to worry about muscle weakness in the extremities, especially in the legs. On 05.05.21, an ECG was performed: sinus bradycardia with a heart rate of 52/min. Intraventricular block. The U-prong. Prolongation of the QT interval. Antihypertensive therapy had no effect. 09.01.22 After the stress, the condition worsened: muscle weakness and numbness in the arms and legs increased. On 10.01.22, the patient was taken by an ambulance team to the neurological department due to a life-threatening decrease in K⁺. On 12.01.22, the patient was transferred to the intensive care unit for further examination and treatment.

According to the patient's medical history, the picture was somewhat similar to hypertension. However, the lack of effect of antihypertensive therapy, conducted according to clinical recommendations, did not fit into this diagnosis. Three times, a randomly detected decrease in the level of K⁺ in the blood and the appearance of muscle weakness and numbness in the arms and legs in the absence of brain complications, characteristic of hypertension, were striking. I was alerted by an ECG with an elongation of the QT interval and the appearance of a U wave, which indicated severe hypokalemia.

Anamnesis vitae: The patient worked as a head teacher at a gymnasium. It is not working at the time of admission to the hospital. Married, two children (2 cesarean sections, 1 frozen pregnancy). Her father's also had episodes of increased blood pressure (up to what numbers he does not remember), her mother's had hypertension. There are no allergic reactions. Bad habits: does not smoke, does not drink alcohol. Previous illnesses: hypertension, chronic cystitis, COVID-19 in October 2021. She did not serve in the army.

According to the life history, the diagnosis of hypertension was supported by family data.

Status praesens objectives. Height: 168 cm, weight: 60 kg, BMI = 21 kg/m². His condition is severe due to weakness in his arms and legs, and his consciousness is clear. The skin and visible mucous membranes are physiologically colored. Peripheral lymph nodes are not enlarged, there is no edema.

Respiratory system: no special features, frequency of respiratory movements - 18 per minute. Breathing is vesicular, there is no wheezing.

Cardiovascular system: The area of the heart does not appear to be altered. The boundaries of the heart are within the normal range. The heart tones are of normal sonority, there are no noises. A pulse of satisfactory filling. Heart rate 96 per minute, blood pressure 160/80 mmHg.

Digestive system: the tongue is covered with a white coating on the back. The belly is soft, painless. The liver and spleen according to M.G. Kurlov are not enlarged.

The urinary system is without features, F.I. Pasternatsky's symptom is negative on both sides. Urination is painless, diuresis is normal.

The discrepancy between the severity of the patient's condition and the physical data characteristic of hypertension with a blood pressure of 160/80 mmHg, as well as the normal size of the liver and spleen with significantly high levels of ALT and AST, is striking.

The following laboratory and instrumental studies were

performed (normal values are indicated in parentheses).

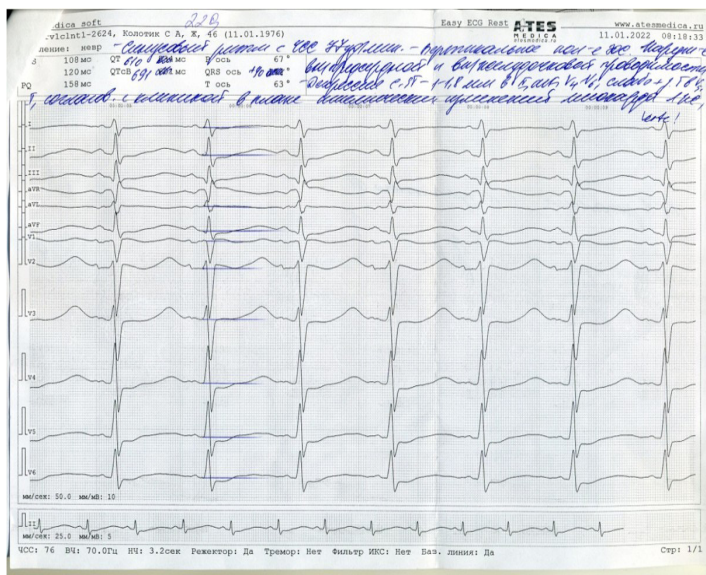
GBC from 11.01.22: erythrocytes: $4.52 \times 10^{12}/l$ ($3.7-4.7 \times 10^{12}/l$), hemoglobin: 118 g/l (120-140 g/L), color index: 0.78 (0.85-1.05), platelets: $344 \times 10^9/l$ (200-400 $\times 10^9/l$); Hematocrit: 32.4% (35-50%); Leukocytes: $10.8 \times 10^9/l$ ($4.0-9.0 \times 10^9/l$), eosinophils: 1% (0-5%), rod-shaped neutrophils: 8% (1-6%), segmented neutrophils: 80% (47-72%), lymphocytes: 9% (18-38%), monocytes: 2% (3-11%), ESR: 17 mm/hr (2-15 mm/hr).

According to the GBC, a slight leukocytosis, a shift of the formula to the left and a slight acceleration of ESR are visible. These data also do not fit into the hypertension picture.

BBT from 10.01.22: calcium: 1.19 mmol/l (1.05-1.3 mmol/L), potassium: 1.55 mmol/L (3.5-5.5 mmol/L), sodium: 141 mmol/L (N 135-155 mmol/L), blood urea: 4.5 mmol/l (2.8-7.2 mmol/L), glucose: 4.9 mmol/L (3.5-5.5 mmol/L), blood amylase: 73.9 U/L (22-80 U/L), total protein: 72.7 g/l (66-83 g/l), blood creatinine: 67 mmol/l (59-104 mmol/L), Quick prothrombin: 88.1% (70-130%), fibrinogen: 4.0 g/l (2-4 g/L), APTT: 35.1 (35-40), INR: 1.1 (up to 1.1), total bilirubin: 10.7 mmol/L (5-21 mmol/L), direct bilirubin: 1.7 mmol/L (3.4 mmol/L), indirect bilirubin: 9 mmol/L (1.7-17.0 mmol/L), total cholesterol: 6.1 mmol/L (up to 5.2 mmol/L), ALT: 208 units/L (<40), AST: 669 (<40).

In the BBT, there is a marked decrease in potassium levels, a significant increase in ALT and AST at normal values of the remaining liver tests and signs, which indicates the absence of hepatitis. The De Ritis coefficient is 3.2, which is typical for cirrhosis of the liver, but there are no other signs of this disease.

ECG dated 11.01.22



This ECG shows a significant prolongation of the QT interval to 0.6, the appearance of a U wave, i.e. criteria for severe hypokalemia.

On 13.01.22, a consultation of hospital doctors and staff of the Department of Hospital and Polyclinic Therapy of KSMA was held. The diagnosis is Primary hyperaldosteronism (Conn's syndrome). MRI of the abdominal organs with targeted analysis of the adrenal glands is recommended [8].

An MRI scan on 15.01.22 revealed a nodular formation in the left adrenal gland up to 0.95 cm.

The diagnosis was based on complaints of general weakness, headache, numbness and weakness in the arms and legs, an increase in systolic blood pressure to 180/100 mmHg, data from apopsis morbi, vitae and status praesens objectives, BBT: K⁺ - 2.22 mmol/L, ECG: signs of hypokalemia, MRI: nodular thickening in the left adrenal gland up to 0.95 cm, and the conclusions of the endocrinologist with the results of tests: an increase in aldosterone to 74.6 ng/dl was detected in the blood, a decrease in renin to 0.5 μ med/ml

On January 28, 22, laparoscopic adrenalectomy was performed on the left.

Blood tests after surgery:

GBC dated 02.01.12: erythrocytes: $4.22 \times 10^{12}/l$ ($3.7-4.7 \times 10^{12}/l$), average volume of erythrocytes: 81 fl (80-100 fl); hemoglobin: 115 g/l (120-140 g/l), color index: 0.82 (0.85-1.05), platelets: $294 \times 10^9/l$ (200-400 $\times 10^9/l$); average platelet volume: 8.32 (7.4-10.4 fl); hematocrit: 34.4% (35-50%); leukocytes: $9.7 \times 10^9/l$ ($4.0-9.0 \times 10^9/l$), eosinophils: 1% (0-5%), rods: 1% (1-6%), segments: 64% (47-72%).

BBT dated 02.01.12: calcium: 2.24 mmol/L (1.05-1.3 mmol/L), potassium: 5.1 mmol/L (3.5-5.5 mmol/L), sodium: 138.6 mmol/L (N 135-155 mmol/L), blood urea: 5.26 mmol/L (2.8-7.2 mmol/L), glucose: 5.19 mmol/L (3.5-5.5 mmol/L), total protein: 77.2 g/l (66-83 g/L), blood creatinine: 73.2 mmol/L (59-104 mmol/L), total bilirubin: 8.5 mmol/L (5-21 mmol/L), ALT: 32 units/L (<40), AST: 24 (<40).

After the operation, all blood tests returned to normal.

On 02.03.12 the patient was discharged in satisfactory condition, with normal GBC and BBT values, and the postoperative wounds healed with primary tension.

It is important to focus on the specifics of this clinical case.

1. Only 11 years after the onset of the disease, a patient with elevated blood pressure was suspected of having Conn's syndrome.
2. Hypertension was set for a long time. The increase in blood pressure and the lack of effect of antihypertensive

therapy in a young 35-year-old woman were not analyzed.

3. A decrease in K⁺ in the blood was not associated with blood pressure.

4. Muscle weakness was not associated with blood pressure and a decrease in K⁺ in the blood.

5. The ECG was inattentively analyzed for signs of hypokalemia and the QT interval (norm 0.34-0.42 ms).

6. The change in ALT and AST levels was attributed to toxic hepatitis. But it proceeds with an increase in ALT more than AST (the De-Ritis coefficient should be 1). The rise in ALT and AST was caused by hypokalemic myopathy. Hypokalemia leads to rhabdomyolysis, which was the cause of myalgia and muscle weakness [7].

The patient was treated in good faith according to the clinical guidelines for hypertension. But there was no effect, because the patient had a different pathology and needed a different treatment, which would clearly help the patient.

Unfortunately, insufficient clinical thinking leads to cases like the one described above. It is precisely the elevation and expansion of the level of clinical thinking that guides have taught and are teaching. They provide a link between rapidly developing medical science and daily practice, translating theoretical knowledge into practical competencies. At the clinical bases of vocational training institutions, doctors have the opportunity to analyze complex clinical cases, learn how to formulate a differential diagnosis, justify the choice of diagnostic and therapeutic tactics, and see their mistakes in a safe educational environment. The teacher does not teach "what to know", but "how to think and act". Unfortunately, perestroika led to the closure of many hydraulic structures. Dubious private organizations have appeared that "train" doctors for money, without giving any knowledge. Almost all medical institutes and universities have opened postgraduate faculties within their walls. But in medical institutes and medical universities, due to the specifics of their tasks, theory and fundamental disciplines occupy most of the time.

Thus, clinical thinking is the basis of a doctor's professional activity, which makes it possible to analyze symptoms, make accurate diagnoses, and choose the optimal treatment strategy. In the context of the rapid development of medicine and the emergence of new diagnostic and therapeutic methods, the formation and improvement of clinical thinking is becoming critically important at the stage of CPE. Doctors with developed clinical thinking make 30-40% fewer diagnostic errors [26].

Improving and expanding the level of clinical thinking is a key area of training for doctors in vocational training institutions. The analysis of the above clinical case convincingly proves

the importance and necessity of improving the level of clinical thinking among doctors in order to form and develop their professional competencies.

Conflict of interest: All authors declare no competing interests.

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