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Yu.I. Karpenko, Mohamed Hanafi

Odessa National Medical University, Odessa

RISK OF COMPLICATIONS IN THE IMPLANTATION OF ARTIFICIAL PACEMAKER SYSTEMS

The purpose of this study was to assess the incidence of various complications of ECS using epi- and endocardial placement of electrodes. There was demonstrated that the occurrence of complications after ECS installation does not exceed 15%. The most frequent complications were the dislocation of electrodes, the formation of microemboli and suppuration in the area of the postoperative wound. The main risk factors for complications were the history of an acute infectious disease and / or fever on the eve of surgery, previous temporary pacing, renal failure, corticosteroids and anticoagulants on the eve of surgery, and insufficient experience of the surgeon. The occurrence of the complications does not depend on the various methods of ECS placement.

Keywords: *artificial pacemaker, heart insufficiency, ventricular dyssynchrony.*

Introduction

In 1889 John McWilliam published the results of an experimental study of the use of electrostimulation in asystole. Almost 40 years later, in 1926 Mark Leadville and Edgar Booth created a portable device for electrostimulation of cardiac activity, which was successfully used in a stillborn child. Five years later, Albert Hyman developed a device called him «an artificial pacemaker». Since then, the use of pacemakers has become routine in the practice of treating rhythm and conduction disorders. The first patient, who was implanted by APM, Arne Larsson, lived after the operation for another 43 years, having replaced 26 devices during this time and survived not only the inventor of the first implantable APM, but also the surgeon who operated him. According to experts, more than 600,000 APM are implanted in the world each year, and the total number of patients living with a pacemaker exceeds 3 million [1, 2]. Conducting biventricular or resynchronizing cardiac pacing can effectively eliminate disturbed coordination in the work of the ventricular myocardium and improve the systolic function of the heart [2, 3].

However, the installation of pacemakers (ECS) may cause a number of complications, such as surgical (perforating in the form of hemo- and pneumothorax, intercostal syndrome, hemopericard and cardiac tamponade, as well as purulent septic ones) and non-surgical, including electrolyte-dissociative complications [4, 5]. The purulent-septic complications include hematomas of the ECS bed, electrode sore, ECS sore, as well as suppuration of the postoperative wound. The unfavorable hemodynamic effects of ECS stand out, including the pacemaker syndrome, a complex of clinical disorders that depends on the adverse hemodynamic and (or) electrophysiological effects of ventricular stimulation, including hypotensive reactions, neurological disorders, and development of circulatory insufficiency. Signs of poorly expressed PMS include neck vein pulsation, fatigue, weakness, malaise, fatigue, palpitation, dizziness, coughing, a sense of fear, heaviness in the chest. With moderate severity of the syndrome, pain in the jaws, chest pain, dizziness, hypotension, dyspnea with physical exertion, changes in thinking, headache. In severe cases, with the appearance of presyncope and syncope, patients can feel even worse with stimulation in the VVI regimen than before implantation of the ECS.

The development of the pacemaker syndrome is associated with a number of mechanisms, of which the leading is the retention of ventriculoatrial conduction with retrograde atrial excitation during electrical stimulation, and in some cases – with the advent of echo-complexes [5]. In some patients with intact VA without a clinically expressed PMS at rest, during exercise with stimulation in VVIR mode, hemodynamics may

not improve, since the beneficial effect of increased heart rate is offset by the unfavorable hemodynamic effect of constant retrograde conduction. Implantation of the VVIR-type ECS does not guarantee the patient from the development of the PMS at rest and / or during physical exertion [5, 6].

PMS can occur in patients with VVIR stimulation in the following situations:

1) continuous stimulation while maintaining VA exercise during exercise;

2) patients with chronotropic insufficiency may remain at normal sinus rhythm at rest, and during an inadequate increase in the frequency of the sinus rhythm leads to the inclusion of ventricular stimulation (with a frequency exceeding the sinus rhythm) with retrograde conduction;

3) VA is dynamic, and in some patients with blocked VA, alone, it can be improved and restored by physical activity under the influence of catecholamines or other factors. Conversely, PMS, observed at rest, may disappear during exercise, if the increase in ventricular stimulation blocks VA conduction.

SC with atrial or two-chamber stimulation is observed in the following situations:

• long programmed AV delay (AR or PR interval> 200 ms);

• EKS-mediated (endless circular) tachycardia;

• stimulation in DDI or DDIR modes (varying PV intervals);

• sinus bradycardia is less frequent than the base frequency when stimulated in VDD mode;

• switching the stimulation mode (from DDDR to VVIR);

• «rhythm smoothing» function for two-chamber stimulation.

A fairly rare cause of MS development may be increased atrial latency (> 40 ms).

The purpose of this study was to assess the incidence of various complications of ECS using epi- and endocardial placement of electrodes.

Material and methods

The study was completed during 2014–2017 on the basis of cardiosurgery department OKB (Odessa, Ukraine). During this period 54 ECS were established, including 21 - with endocardial positioning of electrodes and 33 – with epicardial electrodes. The frequency of intraoperative and postoperative complications was analyzed.

Under local anesthesia, a horizontal incision 6 cm long by 4 cm below the clavicle with the spread of the lateral part of the incision to the s. deltoideopectoralis forms the ECS bed. This allows you to place the stimulator away from the armpit, avoiding its displacement when the arm moves in the shoulder. Under the control of the fluoroscopic system, an endocardial electrode is inserted through the lumen of the vein (v. Cephalica, v. Subclavia, v. Jugularis externa or interna) into the apex of the right ventricle or into the right atrium. The conductor of the second electrode must be inserted through the introducer, the third into the aperture interventricular septum endocardially.

After the introduction of the electrodes, the threshold of electrocardiostimulation and the value of the intracardiac potential (threshold <0.7 V, R-wave amplitude> 5 mV) are determined.The provocative tests for the dislocation of the electrode (hyperventilation and coughing) and stimulation of the diaphragm are carried out. breathing in the vertical position and coughing (with the back position), this did not lead to the dislocation of the electrode due to longitudinal traction or the formation of a loop. The pacemaker is connected to the distal electrode connector is placed in the formed bed (subcutaneously or under the large pectoral muscle).

The statistical analysis was performed using STATISTICA 10.0 software (StatSoft Inc., USA) [7].

Results

As the results of the study showed, the most frequent complications were the dislocation of electrodes, the formation of microemboli and suppuration in the area of the postoperative wound (Table). The main risk factors for complications were the history of an acute infectious disease and / or fever on the eve of surgery, previous temporary pacing, kidney failure, corticosteroids and anticoagulants on the eve of surgery, and insufficient experience of the surgeon.

The frequency of complications in the installation of pacemakers by different methods

Complications	Epicardial location (n=33)	Endocardial location (n=21)
Electrode dislocation	2 (6,1%)	2 (9,5%)
Microemboli	2 (6,1%)	4 (19,0%)
Purulent inflammation	1 (3,0%)	–
PMS	–	–

A more detailed analysis showed that the introduction of a new method of implantation of the pacemaker increased the risk of complications.

For the prevention of complications, we recommend categorical compliance with the rules of asepsis and antiseptics, the use of preoperative sedation (premedication) in any age group, strict adherence to operative-anatomical rules for puncture implantation of electrodes with an adequate choice of intraduser. The adequate size of the intraduser, for puncture of the subclavian vein, should not exceed 7F. Compliance with the rules of patient management in the early postoperative period under the control of anticoagulant and antiaggregant therapy. For the prevention of long-term complications, it is recommended to monitor the function of the pacemaker every 6 months.

It should be noted that in our study there were no cases of PMS. For the prevention of this condition, a change in the mode of electrostimulation, transition to «physiological stimulation regimens» (AAI, DDD, VDD, DDI) is recommended; change in the base frequency of stimulation with the introduction of hysteresis in patients with transient disturbances of AV conduction or weakness of the sinus node if the rhythm itself exceeds 50–60 beats per minute; transition to «frequency-adaptive» stimulation, if a slight increase in the frequency of stimulation develops a ventriculo-atrial blockade that persists with exercise. In a number of cases, a pharmacological or non-pharmacological (transvenous ablation of the AV compound) is used to correct retrograde conduction.

Conclusion

1. The occurrence of complications after ECS installation does not exceed 15%.

2. The most frequent complications were the dislocation of electrodes, the formation of micro-emboli and suppuration in the area of the post-operative wound.

3. The main risk factors for complications were the history of an acute infectious disease and / or fever on the eve of surgery, previous temporary pacing, renal failure, corticosteroids and anticoagulants on the eve of surgery, and insufficient experience of the surgeon.

4. There were no significant differences between various methods of ECS placing.

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Ю.І. Карпенко, Мохамед Ханафі

РИЗИК УСКЛАДНЕНЬ ПРИ ІМПЛАНТАЦІЇ ШТУЧНИХ КАРДІОСТИМУЛЯТОРНИХ СИСТЕМ

Оцінювали частоту різних ускладнень ECS, використовуючи епі- та ендокардіальне розташування електродів. Було продемонстровано, що виникнення ускладнень після встановлення ECS не перевищує 15%. Найчастішими ускладненнями були дислокація електродів, утворення мікроемболів та нагноєння в ділянці післяопераційної рани. Основними факторами ризику ускладнень були історія гострого інфекційного захворювання та / або лихоманки напередодні хірургічного втручання, попередня установка тимчасового стимулятора, ниркова недостатність, призначення кортикостероїдів і антикоагулянтів напередодні операції та недостатній досвід хірурга. Виникнення ускладнень не залежить від різних методів розміщення ECS.

Ключові слова: *штучний кардіостимулятор, серцева недостатність, дисинхронія шлуночків.*

Ю.И. Карпенко, Мохамед Ханафи

РИСК ОСЛОЖНЕНИЙ ПРИ ИМПЛАНТАЦИИ ИСКУССТВЕННЫХ КАРДИОСТИМУЛЯТОРНЫХ СИСТЕМ

Оценивали частоту различных осложнений ECS, используя эпи- и эндокардиальное расположение электродов. Было продемонстрировано, что возникновение осложнений после установления ECS не превышает 15%. Частыми осложнениями были дислокация электродов, образования микроэмболов и нагноение в области послеоперационной раны. Основными факторами риска осложнений были история острого инфекционного заболевания и / или лихорадки накануне хирургического вмешательства, предварительная установка временного стимулятора, почечная недостаточность, назначение кортикостероидов и антикоагулянтов накануне операции и недостаточный опыт хирурга. Возникновение осложнений не зависит от различных методов размещения ECS.

Ключевые слова: *искусственный кардиостимулятор, сердечная недостаточность, диссинхрония желудочков.*

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Contact information

Karpenko Iurii Ivanovych – MD, PhD, Prof., Head of Regional Cardiovascular Centre, Head of department of internal medicine №1 and cardio-vascular pathology Odessa National Medical University.

Mohamed Hanafi – post-graduate student of the Department of Internal Medicine № 1 and cardiovascular pathology Odessa National Medical University.

Address: Ukraine, 65025, Odessa, 26, Zabolotnogo St.

Tel.: +380936487061.

E-mail: mohamedhanafi22@yahoo.com