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ПЕРИОПЕРАЦИОННОЕ ВЕДЕНИЕ ПАЦИЕНТОВ С РЕВМАТОЛОГИЧЕСКИМИ ЗАБОЛЕВАНИЯМИ: КАРДИОВАСКУЛЯРНЫЕ РИСКИ, ПРОФИЛАКТИКА ИНФЕКЦИОННЫХ И ТРОМБОЭМБОЛИЧЕСКИХ ОСЛОЖНЕНИЙ, ОТДЕЛЬНЫЕ СОСТОЯНИЯ

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Perioperative Management of Patients with Rheumatic Disease: Cardiovascular Risks, Prevention of Infectious and Thromboembolic Complications, Other Conditions

Резюме

В данной статье обсуждаются риски и профилактика инфекционных, тромбоэмболических осложнений, кардиоваскулярные риски, а также различные структурные изменения опорно-двигательного аппарата и неопорных суставных структур, которые затрудняют периоперационное ведение ревматологических пациентов.

Ключевые слова: *ревматоидный артрит, периоперационное ведение, эндопротезирование, антифосфолипидный синдром, атланто-аксиальная нестабильность, височно-нижнечелюстные суставы, перстнечерпаловидные суставы*

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Abstract

In the first part we reviewed the issues of perioperative administration of steroids, disease-modifying antirheumatic drugs, biologics and nonsteroidal anti-inflammatory drugs. In this part we will discuss cardiovascular risks, prevention of infectious and thromboembolic complications and the impact of some structural alteration on the process of surgery and perioperative management.

Key words: *rheumatoid arthritis, perioperative management, arthroplasty, antiphospholipid syndrome, atlantoaxial subluxation, temporomandibular joints, cricoarytenoid arthritis*

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AAI — atlantoaxial instability, AAJ — atlantoaxial joint, ABP — antibiotic prophylaxis, ADI — atlantodental interval, AOJ — atlantooccipital joint, APLAT — antiphospholipid antibodies, APS — antiphospholipid syndrome, CT — computed tomography, CS — cervical spine, CVR — cardiovascular risk, DVT — deep vein thrombosis, IE — infective endocarditis, JIA — juvenile idiopathic arthritis, LMWH — low molecular weight heparins, MRI — magnetic resonance imaging, RA — rheumatoid arthritis, RDs — rheumatological diseases, SAI — subaxial instability, SLE — systemic lupus erythematosus, TMJ — temporomandibular joint, UFH — unfractionated heparin, VTE — venous thromboembolism

Risk of developing infectious complications

Patients with rheumatological diseases (RDs) have an increased risk of infectious complications, primarily due to the long-term use of immunosuppressants. In this regard, preventive measures should be carefully taken. The decision on the use of antibiotics should be taken with consideration to the type of surgical intervention and risk-benefit evaluation.

1. Detection of latent infections and antibiotic prophylaxis (ABP)

When preparing patients with RDs for surgical intervention, one should look for caries, asymptomatic bacteriuria, cystitis, pharyngitis, skin infections (special attention should be paid to the skin of the feet) [1]. All these conditions can become a source of postoperative infectious complications.

In patients with RD, physicians use the same perioperative protocols for ABP in regard to surgical infections as in the general population [2].

In particular, endoprosthesis replacement in patients with normal kidney function requires the use of cefazolin 1 g i.v. in case of a patient with body weight less than 80 kg, and 2 g i.v. in case of a patient with body weight more than 80 kg; the agent is administered within 60 minutes after incision, and then every eight hours for one day. In patients with an allergic reaction to penicillin, it is recommended to use vancomycin i.v. at a dose of 1 g (10–15 mg/kg) two hours before surgery with a single repeated administration during the postoperative period after 12 hours, or clindamycin at a dose of 600–900 mg i.v. with repeated administration twice during the postoperative period with an interval of six hours. Clindamycin is less effective against coagulase-negative staphylococci and MRSA (methicillin-resistant Staphylococcus aureus) than vancomycin. Continued prophylactic administration of antibiotics for more than 24 hours after surgery is not advisable [3].

2. Prevention of infective endocarditis (IE) in patients with valvular heart diseases due to RDs during dental procedures and minimally invasive interventions (based on the European Society of Cardiology (ESC) Guidelines for the management of infective endocarditis, 2015) [4].

The idea of IE ABP was developed based on survey studies and animal models [5]. It was assumed that ABP

would interfere with bacterial adhesion to the endocardium during transient bacteremia after invasive procedures. This led to the mass prophylactic prescription of antibiotics to patients with the structural features of heart valves before various interventions, including dental procedures.

In recent years, the development of pathophysiological concepts, as well as the study of the risks and benefits of IE ABP, narrowed down the indications for this type of prophylaxis in patients with valvular heart diseases. Current ideas about the advisability of IE ABP are based on the following provisions:

- Low-level and recurring bacteremia often develops during normal daily activities such as tooth brushing, flossing, or chewing gum, especially in patients with incomplete oral sanation. Therefore, the risk of IE is probably associated with cumulative exposure to mild bacteremia throughout the day rather than with single severe bacteremia after dental procedures.
- Most case-control studies showed no link between invasive dental procedures and IE development.
- The estimated risk of IE after dental interventions is very low. Therefore, ABP can prevent a very small number of IE cases (approximately 1 in 150,000 interventions with antibiotics, or 1 in 46,000 without antibiotics) [4].
- Using antibiotics is associated with a certain risk of allergy and anaphylaxis.
- Heavy use of antibiotics contributes to the emergence of resistant microorganisms.
- Efficacy of ABP against bacteremia and IE development was confirmed only in animal models; there are contradictory data in humans.

Recommendations support the advisability of ABP in patients with a high risk of developing IE that can be divided into three categories. In particular, *ABP is recommended for patients with prosthetic valves; patients with previous IE, and patients with untreated cyanotic congenital heart diseases (CHD) and CHD after palliative bypass surgery, conduits or other prostheses.*

ABP is not recommended for patients with an intermediate risk of IE that includes any other form of native valvular heart disease.

Therefore, *patients with non-operated valvular heart disease are at intermediate risk, and patients with operated/prosthetic valves are at high risk.* The population of rheumatological patients is primarily understood as patients with valvular heart diseases that have developed as a result of acute rheumatic fever. Also, it should be borne in mind that heart damage with the development of valvular disease can also occur as a part of other RDs, particularly seronegative spondyloarthritis, systemic lupus erythematosus (SLE), and antiphospholipid syndrome (APS).

ESC Guidelines emphasize that both intermediate and high-risk patients should be advised on the importance of oral and skin hygiene. Particular attention should be paid to the general compliance with basic hygiene standards, since IE often develops in individuals with no known heart disease.

3. IE ABP in dental procedures

Procedures in the gums and periapical region of the teeth associated with possible injury to the oral mucosa (including procedures with roots and removal of tartar) carry a certain risk of infection. Dental implants are also associated with the potential risk of infection from the buccal region entering the bloodstream. However, there is very scarce information on this subject, and there is no sufficient evidence of contraindications to implants in high-risk patients.

ABP is advisable in patients with a high risk of IE who undergo these high-risk dental procedures and is not recommended in other situations [4]. Streptococci of the oral cavity are the main object of ABP in such cases. Table 1 presents basic ABP regimens recommended before dental procedures. Fluoroquinolones and glycopeptides are not recommended due to their unclear efficacy and potential development of resistance. Cephalosporins should not be used in patents with a history of anaphylaxis, angioedema, or urticaria to penicillin or ampicillin due to cross-sensitivity.

ABP in non-dental procedures and interventions

There is no strong evidence that bacteremia after interventions in respiratory, gastrointestinal and genitourinary tracts, including vaginal delivery and caesarean section, as well as dermatological and musculoskeletal procedures, causes IE. Systemic ABP of IE is not recommended for non-dental interventions. Antibiotics are required only when invasive procedures are performed with an underlying infectious process [4].

Table 1. *Recommended prophylaxis for high-risk dental procedures in high-risk patients [4]*

Situation	Antibiotic	Single-dose 30-60 minutes before procedure	
		Adults	Children
No allergy to penicillin or ampicillin	Amoxicillin or ampicillin*	2 g orally or IV	50 mg/kg orally or IV
Allergy to penicillin or ampicillin	Clindamycin	600 mg orally or IV	20 mg/kg orally or IV

Note: *Alternatively, cephalexin 2 g IV for adults or 50 mg/kg IV for children, cefazolin or ceftriaxone 1 g IV for adults or 50 mg/kg IV for children. IV — intravenous

Assessment of cardiovascular risk and prevention of thrombotic complications

Patients with RDs (especially those with rheumatoid arthritis, SLE, and systemic vasculitis) have an increased cardiovascular risk (CVR) compared to the general population. Therefore, regular risk assessment is required (at least once every 5 years) [6]. Assessment of CVR in patients with RDs is based on special scales and periodic examinations aimed at identifying risk factors.

First of all, the patient's CVR should be evaluated according to the SCORE algorithm or Framingham Risk Score. There are special features of using SCORE in patients with RA: in certain cases it is recommended to multiply the SCORE value by 1.5, that is, with a disease duration of more than 10 years, with positive rheumatoid factor (RF) or cyclic citrulline peptide antibodies (CCPA), with extra-articular manifestations of RA [6].

Furthermore, in order to get more specific information on the risk, a Doppler scan of carotid arteries is recommended [6].

CVD risk factors in patients with high and very high CVR should be promptly corrected [6].

Assessing exercise tolerance in patients with rheumatologic diseases can be difficult, as these patients often have limited mobility due to musculoskeletal diseases, or reduced overall physical activity due to the damage to the heart, lungs, and other disease-related changes. In this regard, standard functional tests with exercise are challenging or impossible for such patients. Currently, there are no strong recommendations on alternative methods for assessing exercise tolerance in patients with RDs.

In addition, specific CVR factors in rheumatological patients, such as signs of antiphospholipid syndrome (APS), should be considered. See features of the management of patients with APS in "Prevention of thrombotic complications".

Perioperative administration of acetylsalicylic acid

It is recommended to stop the administration of acetylsalicylic acid 7–10 days before surgery, that is, for the platelets' lifespan [7]. This excludes patients with a high risk of myocardial infarction, transient ischemic attacks and stroke; risks in such cases should be assessed individually [7].

According to the American College of Chest Physicians (ACCP) recommendations [8], patients with moderate to high CVR receiving acetylsalicylic acid as secondary prophylaxis should continue taking it in the perioperative period. Also, it should be considered that rheumatic disease itself is a factor for CVR. Patients with signs of APS, positive antiphospholipid antibodies (especially with triple positivity) deserve special attention. These patients are at high risk of a first thrombotic event. Therefore, considering the relatively low risk of life-threatening bleeding in connection with the administration of acetylsalicylic acid, and if there are no other serious contraindications, patients with RDs can continue taking acetylsalicylic acid in the perioperative period. The therapeutic approach to the perioperative management of a patient with APS (using the example of endoprosthesis replacement) is demonstrated in Diagram 1 [2].

In some cases, hydroxychloroquine and statins can be recommended as additional angioprotective measures [2].

Prevention of venous thrombosis

1. Basic principles of the management of patients with RDs in the perioperative period in order to prevent venous thrombosis [1]:

- reducing time without anticoagulants;
- not using vitamin K;
- minimizing all factors of Virchow's triad (stasis, hypercoagulable state and endothelial damage): using external pneumatic compression during the operative and postoperative period, if possible, inflating the tonometer cuff less often, avoiding the use of tourniquets, motivating the patient towards early activation, limiting the use of intravenous infusion systems and removing them as early as possible.

1. Standard approaches [1]:

Warfarin sodium (WS) for 10 days after surgery with dose titration in order to achieve target prothrombin time 16–18 seconds, or INR 2–3. WS continued up to 42 days after hip joint surgery may be associated with a lower risk of deep vein thrombosis. WS for more than 10 days in the postoperative period after knee arthroplasty has no additional effect.

Unfractionated heparin (UFH) 5,000 IU subcutaneously before surgery, then 5,000 IU every 8 hours after surgery. Subsequently, the dose is titrated daily depending on the activated partial thromboplastin time (aPTT) that should increase 1.5–2.5 times higher than the control one. The frequency of administration, the need for frequent testing for aPTT and the cost limit the advisability of using UFH.

Low molecular weight heparins (LMWHs) may also be effective for prevention. The most effective regimen includes starting administration before surgery and continuing for at least 10 days after surgery. It was demonstrated that in cases of hip arthroplasty, continued use of LMWHs up to 42 days during the postoperative period reduces the incidence of deep vein thrombosis with no significant increase in the frequency of bleeding episodes.

Fondaparinux sodium (synthetic heparin) — administration before surgery with a continuation of up to 10-42 days the during postoperative period.

Acetylsalicylic acid (325 mg/s) moderately reduces the incidence of deep vein thrombosis. However, it is associated with an increased risk of bleedings and is not recommended for routine perioperative prophylaxis of deep vein thrombosis.

Pneumatic compression devices applied to the lower extremities should be used from the morning before surgery until the moment of discharge. **Compression stockings** provide minimal protection against deep vein thrombosis and are not recommended as monotherapy.

2. Specific features of DVT prevention in patients with RA in the perioperative period after knee or hip arthroplasty [7]:

Before surgery, all patients should undergo ultrasound of the veins of lower extremities with re-examination before the "verticalization" of a patient after surgery and before his/her discharge from the hospital.

Ten to fourteen days before surgery, patients receiving **WS** should be switched to LMWHs under the control of coagulogram and several parameters:

- before starting LMWHs — CBC (including platelets), blood biochemistry to exclude renal failure (creatinine);
- after 5–7 days of LMWHs administration — repeated control of platelets (to exclude heparin-induced thrombocytopenia).

In the postoperative period, early activation of patients is recommended, as well as exercises for lower extremities with the mandatory engagement of the muscles of lower legs; elastic bandages or special garment (socks, stockings) for at least 60–90 days from the day of surgery, and administration of dabigatran etesquilate or rivaroxaban.

Dabigatran etexilate is a selective direct thrombin inhibitor:

- the first dose (110 mg) should be administered 1–4 hours after surgery;
- from day 2 — 220 mg (2 capsules 110 mg once a day); for patients aged 75+ — 150 mg (2 capsules 75 mg); duration of administration — at least 35 days;
- this agent does not require individual dose titration or laboratory control (approved by the European Medical Agency (EMEA) for thromboprophylaxis after knee or hip arthroplasty).

Rivaroxaban is a selective direct inhibitor of blood coagulation factor Xa: the first dose (10 mg) should be administered 6–10 hours after surgery, then 10 mg once a day for at least 35 days.

For patients undergoing major orthopedic surgery, the American College of Chest Physicians recommends extending outpatient thromboprophylaxis up to 35 days from the date of surgery, and using an intermittent pneumatic compression device during hospital stay [2].

3. Special features of the perioperative management of patients with APS [2]

There are procedures for primary and secondary prevention of thromboembolic complications in patients with APS.

For ***primary prevention*** in patients with RDs, perioperative risk stratification should be based on the antiphospholipid antibody (APL-Ab) profile and other cardiovascular risk factors, considering that the RD itself increases the risk of venous thromboembolism.

The strongest predictors of clinical manifestations in APS are lupus anticoagulant, which increases the risk of thrombosis by about four times [2], as well as "triple positivity", which is a significant increase of all three APL-Abs (lupus anticoagulant, anticardiolipin, anti-b2-glycoprotein antibodies), while Ig G isotype is clinically more significant compared to Ig M one (Diagram 1) [8].

Other risk factors for cardiovascular diseases should also be included in the risk assessment, such as arterial hypertension, obesity (body mass index > 30 kg/m^2), diabetes mellitus, smoking, active or treated cancer, oral contraceptives, underlying systemic autoimmune diseases, and genetic hypercoagulant conditions that may require an increased dose of anticoagulants during the perioperative period [9].

Patients with RDs and clinically significant APS have a very high risk of thrombosis. Therefore, physicians should try to perform the least invasive type of surgery. On the other hand, the following is required to reduce the risk of bleeding [2]:

- discontinuing oral anticoagulation agents 3–5 days before surgery;
- treatment with heparin or LMWHs should be discontinued 4 or 24 hours before surgery, respectively,
- re-starting anticoagulants 24–48 hours after the intervention if hemostasis is adequate (Scheme 1).

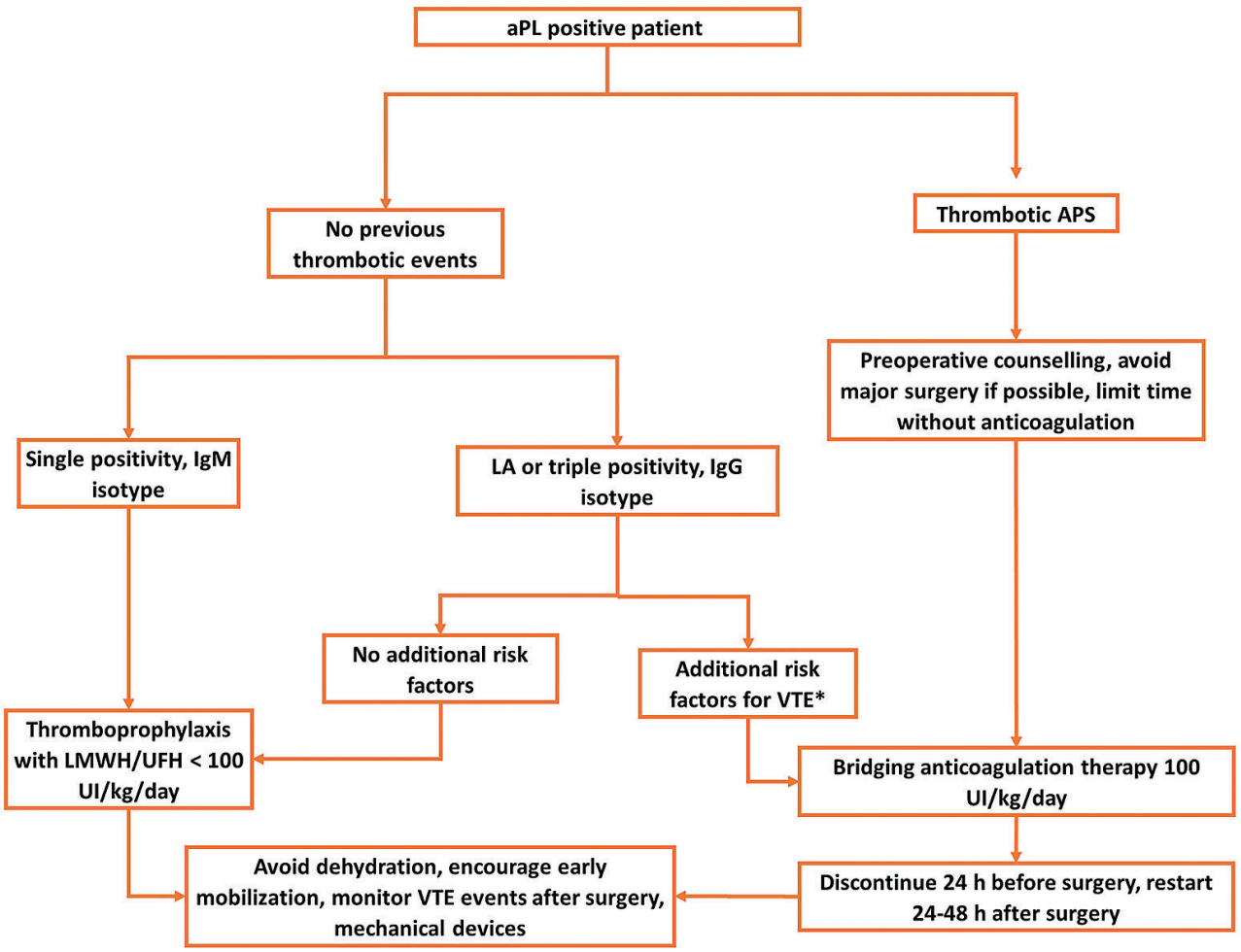
For ***secondary prevention*** of venous thromboembolism, considering the risk of recurrence after the first episode of thrombosis, patients with APS receive oral anticoagulants for a long time. Therefore, they also need bridge therapy with subcutaneous LMWHs or intravenous UFH [2].

According to the literature, hydroxychloroquine reduces the risk of venous thromboembolism in SLE [10] and slows down the progression of atherosclerosis [11].

Structural changes in the spine and joints that affect the perioperative management of patients with RDs

1. Pathology of the upper cervical spine in patients with rheumatoid arthritis (RA)

Rheumatoid arthritis can affect all parts of the spine. However, the cervical region is most commonly affected (in 59–88 % of patients), which is associated with the risk of severe complications [12].



Scheme 1. *Perioperative approach to a patient with inflammatory rheumatic disease and venous thromboembolic risk [2]*

Note: aPL — antiphospholipid antibodies, LA — lupus anticoagulant, APS — anti-phospholipid syndrome, VTE — venous thromboembolism, LMWH — low molecular weight heparin, UFH — unfractionated heparin

*Additional risk factors for VTE: arterial hypertension, obesity, diabetes mellitus, smoking, neoplasia, oral contraceptives, underlying inflammatory joint disease, genetic hypercoagulable state

There are 32 synovial joints in the cervical spine (CS) [13], and all of them can be exposed to inflammation and further destruction. Atlantoaxial (AAJ), atlantooccipital (AOJ), and facet joints of the upper cervical vertebrae are most commonly affected. In most cases, arthritis of these joints is asymptomatic. However, in cases of especially aggressive inflammation and proliferation of rheumatoid pannus, there is significant degeneration and destruction of all joint structures [14]. As a result, static and/or dynamic instability of CS develops, which can lead to the compression of the spinal cord and brainstem. There are three types of CS deformities in cases of RA: atlantoaxial instability, basilar impression (atlantooccipital instability), and subaxial cervical instability [13]. AAJ and AOJ instability develop due to the degeneration of the ligamentous apparatus, while the destruction of facet joints plays the central role in the pathomorphosis of subaxial instability [13].-

Atlantoaxial instability (AAI). Atlantoaxial instability (subluxation) is the most common pathology of the cervical region in the cases of RA (65 % of CS deformities in RA), which raises the threat of developing cervical myelopathy [13]. Depending on the direction of dislocation of C1 relative to C2, AAI can be divided into anterior (most common), posterior, vertical, lateral and rotational[14]. AAI develops when the integrity of the ligamentous apparatus is impaired due to synovial proliferation: primarily when the transverse (prevents anterior displacement of atlas) and alar (stabilization during axial rotation of the head) ligaments are weakened (Figure 1).

Most patients with AAI are asymptomatic. [15]. However, *deep flexion/extension in the cervical region (for example, during intubation) can result in a significant displacement of the odontoid process with the development of spinal cord compression*. In this regard, patients with RA, during their preparation for surgery, should undergo X-ray of the cervical spine with functional tests (anteroposterior, lateral, with the mouth open, flexion, extension) [14].

X-ray to detect instability is mandatory for the following groups of patients [12]:

- RA duration of at least 10 years;
- aggressive course of RA with a disease duration of less than 10 years;
- patients with symptoms of AAI (pain and/or paresthesia in the neck and nape, signs of cervical myelopathy).

There is also an opinion that X-ray should be performed in all patients with RA, especially in those who are scheduled for general anesthesia, since about half of patients with radiological instability are asymptomatic [12].

X-ray or computed tomography (CT) can help detect AAI by diagnosing the displacement of the odontoid process. To this end, *anterior and posterior atlantodental intervals (ADI) are measured* [13].

Anterior ADI is the distance from the lower edge of the C1 anterior arch to the anterior surface of the C2 odontoid process (see Figure 2). *The normal interval should not be more than 3 mm on lateral radiographs in the position of flexion and extension.* A distance of more than 3 mm indicates the failure of the transverse ligament. A displacement of more than 7–8 mm indicates complete destruction of ligaments and high risk of spinal cord compression. A displacement of 9 mm is accompanied by the development of severe neurological symptoms.

Posterior ADI is the distance from the posterior surface of the odontoid process to the anterior edge of the C1 arch plate (see Figure 2). At a distance of less than 13 mm, there is a risk of spinal cord compression.

All patients with radiographic evidence of instability are recommended to undergo more detailed imaging by CT or magnetic resonance imaging (MRI) of CS [14].

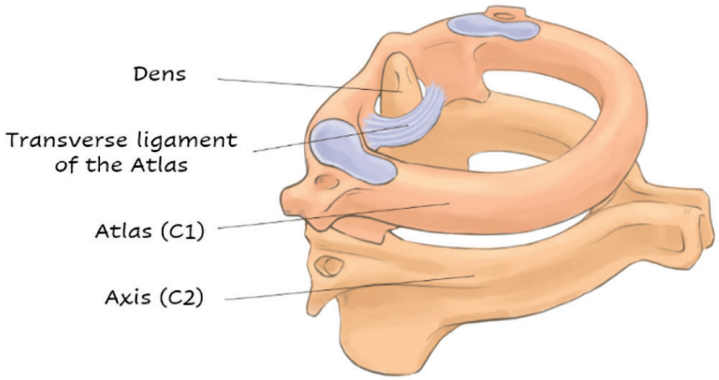


Figure 1. *Atlantoaxial joint. Illustrator Rudykh A.K.*

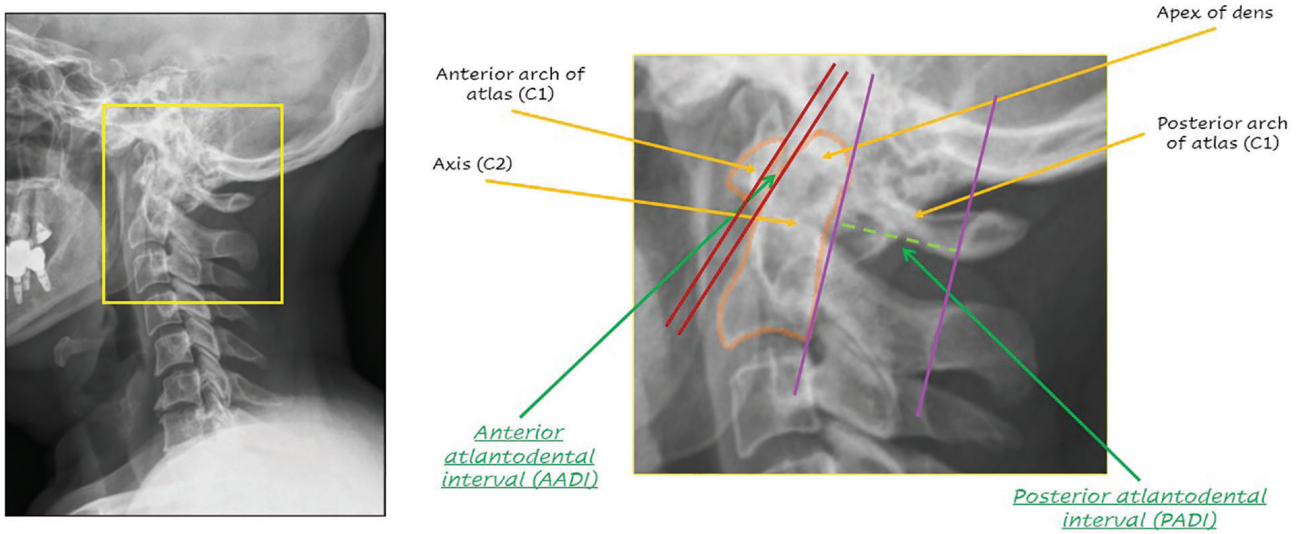


Figure 2. *Measurement of the anterior and posterior atlantodental interval*

Figure **caption 2** [16]**:**
Measuring the anterior atlantodental interval: A line is drawn along the anterior arch of the atlas connecting the most posterior points of its superior and inferior borders. Then a second, parallel line is drawn along the anterior aspect of the dens. The distance between the two lines is the anterior atlantodental interval (AADI), which can be measured in the neutral position and also in flexion and extension. Values > 3 mm are considered suspicious. Widening of the AADI to > 5 mm strongly suggests rupture or inflammatory damage to the transverse atlantal ligament.
Measuring the posterior atlantodental interval: A line is drawn along the posterior arch of the atlas connecting the most anterior points of its superior and inferior borders. The distance between that line and a parallel line along the posterior aspect of the dens is the posterior atlantodental interval (PADI). In patients with atlantoaxial instability due to rheumatoid arthritis, values < 10 mm are critical in terms of spinal canal encroachment and possible spinal cord compression.

Benefits and capabilities of CT CS [14]**:**

- good visualization of bone contours (assessment of the position of the C1, C2 odontoid process relative to the foramen magnum and the relation between upper cervical vertebrae, measurement of intervals);
- detection of spinal cord compression by assessing subarachnoid space, weakening of the transverse ligament, as well as changes in bones and soft tissue;
- contrast-enhanced CT visualizes vascular abnormalities and inflammatory soft tissue proliferation in cases when MRI cannot be performed. However, MRI is usually better for soft tissue imaging.

Benefits and capabilities of MRI CS in a patient with RA [14]**:**

- assessment of nervous structures (MRI is the method of choice for the symptoms of myelopathy or radiculopathy);
- assessment of pannus prevalence;
- assessment of the degree of damage to the ligaments (rupture or sprain);
- high sensitivity for detecting inflammation in joints before the development of instability;
- visualization of vertebral bone marrow edema;

It should be noted that in many cases, MRI underestimates the degree of atlantoaxial subluxation compared to common functional X-ray [17]. In this regard, MRI should be augmented with X-ray, if it has not already been performed.

Other types of cervical spine instability in RA

The second most common cervical lesion in RA (20 %) is *basilar impression (cranial lowering, or superior odontoid migration)*. It develops as a result of the impaired integrity of AOJ and AAJ, which leads to the displacement of the odontoid process into the foramen magnum. Compression of the brainstem may result from such displacement. Detecting superior migration of the odontoid process on X-ray images is extremely difficult, as bone erosion and/or superimposition of various structures of the skull and spine make the identification of anatomical landmarks difficult. Therefore, X-ray is recommended as a screening examination with data assessment according to Clark's, Ranawat's and Redlund-Jonell's criteria [13].

The third most common cervical damage in RA (15 %) is *subaxial (C3–C7) instability (SAI)*. This deformation is due to synovitis and the destruction of facet joints, ligaments and intervertebral discs. The horizontal displacement of vertebrae relative to each other can lead to the compression of the spinal cord and/or cervical nerve roots. Such instability develops on several levels at once and can be fixed or mobile. According to X-ray results, a vertebral displacement of more than 20 % or 3.5 mm is considered significant. The diameter of the subaxial spinal canal should be measured from the posterior surface of the vertebral body to the ventral plate. A canal diameter of less than 13 mm on its sagittal view suggests an increased risk of developing a neurological deficit. MRI is helpful in diagnosing SAI, as the actual canal diameter may be smaller than suggested by bone measurements due to pannus [13].

Clinical signs that point to CS damage in RA patients

Structural abnormalities in CS may be accompanied by the symptoms of myelopathy, radiculopathy, vertebrobasilar insufficiency, cranial nerve involvement, and episodes of medulla oblongata dysfunction, as well as auscultatory and positional phenomena [14].

The earliest and the most common symptom of CS instability is neck pain radiating to the nape due to synovitis.

Typical signs of cervical **myelopathy** are paresthesia and numbness in the limbs, muscle weakness, spasticity or atrophy, gait disturbance, loss of agility in movement, increased deep tendon reflexes, Babinski and Hoffman symptoms, clonus, impaired bowel and bladder functions. Ranawat's classification can be used to assess the severity of myelopathy [18].

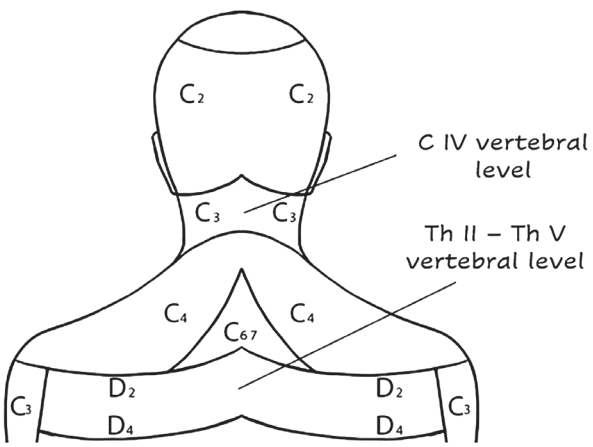


Figure 3. *Innervation of the cervical segments*

Symptoms of **radiculopathy** depend on the affected root (Figure 3) and are represented by decreased deep tendon reflexes, weakness, sensory loss, as well as positive Spurling test. Radiculopathy is especially common in patients with *subaxial subluxations* [14].

The development of **vertebrobasilar insufficiency** can be indicated by dizziness, sometimes accompanied by syncopal episodes, drop attacks, when the patient suddenly feels weak in the legs and falls without loss of consciousness, diplopia and loss of vision, etc. [14].

In some cases, the compression of V and VIII pairs of **cranial nerves** develops. An impaired V pair (trigeminal nerve) primarily leads to decreased sensitivity in the area of its innervation. Compression of the VIII pair (vestibulocochlear nerve) can be evidenced by oscillopsia (feeling of constant movement of surrounding stationary objects). C2 *superior odontoid migration* may lead to medulla oblongata compression and transient episodes of **medulla oblongata dysfunction** (for example, irregular breathing and bradycardia, etc.). Sudden death due to medulla oblongata compression was described in 10 % of cases of superior C2 migration. However, the actual frequency is unknown due to the difficulty in determining the cause of death [19].

Atlantoaxial subluxation can lead to symptoms of myelopathy, sensor loss and paresthesia in the area of C2 innervation (greater occipital neuralgia), decreased sensitivity in the area of the trigeminal nerve, nystagmus. When tilting the head forward, one can hear a dull click and/or feel the head "falling".

Therefore, when examining a patient with suspected structural changes in CS, attention should be paid to the following signs [20]**:**

- feeling of the head "falling" during flexion in the cervical region;
- changed level of consciousness;
- drop attacks;
- bowel and bladder dysfunction (loss of sphincter control);
- respiratory dysfunction;
- dysphagia, dizziness, convulsions, hemiplegia, dysarthria, nystagmus;
- peripheral paresthesia with no signs of peripheral nerve compression;
- Lhermitte phenomenon ("electrical" sensation in the neck with irradiation through the spine or into the upper limbs that occurs during cervical flexion);
- instability that cannot be explained by rheumatic joint disease;
- hand clumsiness, falling of objects from the hands that cannot be explained by rheumatic joint disease.

Identification of these signs raises the need to consult a spinal surgeon to define further treatment approach.

Patients with severe instability are recommended to undergo a stabilizing surgery in the upper cervical region, and only after that — elective surgical treatment with tracheal intubation [12].

In general, in cases of CS involvement, fiberoptic intubation or, in some cases, tracheostomy is recommended [12].

2. Pathology of temporomandibular joints (TMJ)

More than 50 % patients with RA have symptoms of TMJ damage; radiological changes in these joints are found in 78 % of patients [21]–[23] TMJ involvement can lead to narrowed mouth opening, which makes it difficult to intubate the trachea [12]. In this regard, when planning a surgery, it is recommended to palpate TMJ for soreness and/or crepitus when opening the mouth and assess the oral aperture. Measurement of mouth opening can be carried out, particularly using a three-finger index [24].

3. Arthritis of cricoarytenoid joints

Cricoarytenoid joints are formed by the articular surfaces at the base of the arytenoid cartilage and the upper edge of the cricoid cartilage plate (Figure 4). Movements in this area occur around a vertical axis.

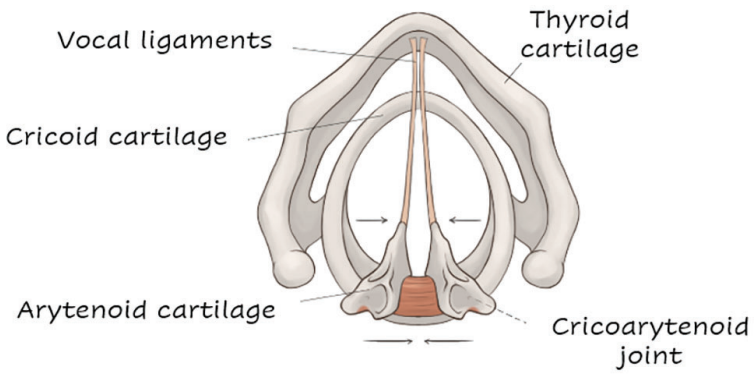


Figure 4. *Cricoarytenoid joint.*
Illustrator Rudykh A.K. According to Gross anatomy, D.A. Morton et al. with modifications [26]

The work of these joints ensures the narrowing and expansion of the glottis. Cricoarytenoid joint involvement in RA patients is found in 45–88 % of pathological examinations and in 30 % of patients in clinical trials [21, 23, 25]. Clinically, synovitis of these joints is manifested by pain in the throat, the anterior neck, sudden shortness of breath on exertion, hoarseness, dysphagia, odynophagia, and in rare cases, suffocation [23], [25]. Attempts of endotracheal intubation by standard methods in such patients, especially after several attempts to insert the tube, lead to trauma of the vocal cords [12]. After extubation, stridor and airway obstruction may develop, which requires emergency tracheostomy [12]. In cases of damage to cricoarytenoid joints, fiberoptic intubation is recommended [12].

If cricoarytenoid joint damage is suspected, preoperative indirect laryngoscopy is advised [12]. Prophylactic minitracheostomy should also be considered in several cases [16]. It should be borne in mind that patients with RA may have combined damage to the cervical spine, TMJ, and cricoarytenoid joints.

4. Kyphotic spine deformity

Kyphotic deformity of the spine is a condition when there is an increase in the natural curvature of the spine in the sagittal plane, leading to a typical deformity [27]. The three most common causes are postural kyphosis, Scheuermann's kyphosis secondary to Scheuermann-Mau disease, and congenital kyphosis [28]. In addition, such a deformity may be due to an injury or fracture, as well as a degenerative process [27]. In rheumatologic cases, the kyphotic deformity is more common compared to the others due to the development of Bechterew's disease with a typical "beggar's posture", as well as in osteoporosis ("widow's hump") (Figure 5).

Spondyloarthritis in Bechterew's disease starts with the lumbar spine, gradually involving the thoracic and cervical areas [29]. In the case of ankylosis, mobility of the spine is completely lost. Two types of deformation may develop: excessive thoracic kyphosis ("beggar's posture") or loss of physiological spine curves ("proud posture") [30]. In both cases, intubation by standard methods will be difficult due to the lost mobility of the neck and the risk of injury when trying to force flexion/extension. Fiberoptic intubation is recommended in these patients. Moreover, extensive calcification of ligaments and heterotopic ossification may result in difficulties when performing regional anesthesia [31].

In case of excessive thoracic kyphosis, a patient is unable to place his/her head with the nape on a horizontal surface; it should be considered when laying the patient. It is important to keep in mind that many patients with ankylosing spondylitis have limited chest expansion and associated ventilation problems [31].

Conclusion

Rheumatological diseases lead to motor restrictions, impaired structure and decreased function of many organs and systems, as well as the need for constant administration of various medications. All this raises the risk of various intraoperative and postoperative complications. Specific features of patients with rheumatological diseases should be considered in perioperative management.

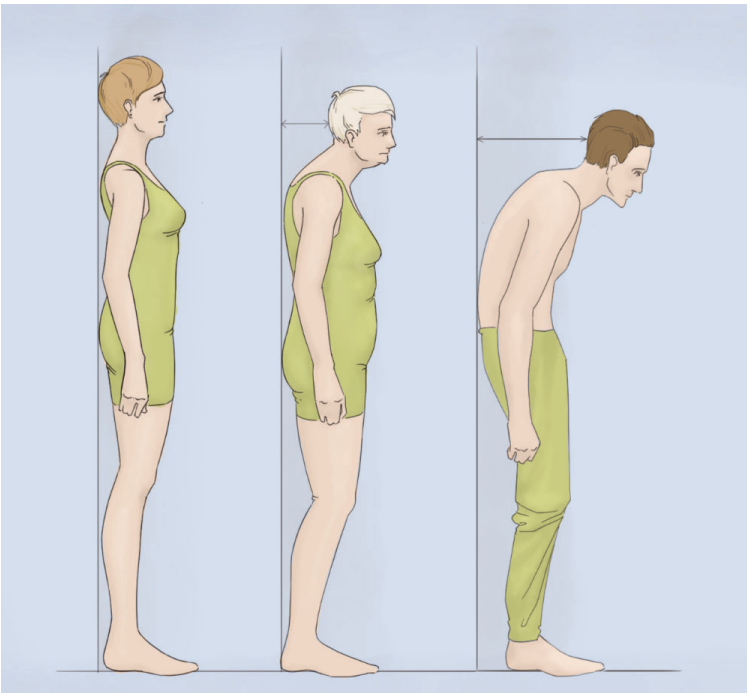


Figure 5. *Kyphotic deformity of the spine in patients with osteoporosis and ankylosing spondylitis. Illustrator Rudykh A.K.*

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