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BAKTERIOLOGIK SEPSIS DIAGNOSTIKASI VA DAVOLASH USULLARI

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Annotatsiya. *Ushbu maqolada bakteriologik sepsisning zamonaviy tibbiyotdagi dolzarbligi, patogenezi, diagnostikasi va davolash tamoyillari kompleks tarzda yoritilgan. Sepsis infeksiyaga organizmning disrregulyatsiyalangan javobi natijasida rivojlanadigan, ko'p a'zoli yetishmovchilik va yuqori o'lim darajasi bilan kechuvchi og'ir klinik sindrom ekani ta'kidlanadi hamda Sepsis-3 xalqaro konsensus ta'rifiga asoslanadi. Asosiy etiologik omillar sifatida Gram-manfiy va Gram-musbat bakteriyalar, shuningdek antibiotiklarga rezistent shtammlarning ko'payib borayotgani alohida muammo sifatida ko'rsatib o'tilgan. Patogenezda PAMP–TLR mexanizmi orqali sitokin bo'roni, endotelial shikastlanish, mikrosirkulyatsiya buzilishi va immunparalich holatining rivojlanishi muhim o'rin tutishi bayon etilgan. Diagnostikada SOFA va qSOFA skorlari, laktat darajasi, biomarkerlar (CRP, prokalsitonin, presepsin) hamda qon bakteriologik ekmasi asosiy vositalar sifatida ko'rsatilgan. Shu bilan birga, an'anaviy bakteriyalarni ekish usullarining vaqt talab qilishi sababli multipleks PCR, FilmArray BCID panellari va kelajakda metagenomik sekvensiya kabi tezkor va bakteriyalarni o'stirmasdan aniqlash texnologiyalarning ahamiyati ortib borayotgani ta'kidlangan. Davolashda esa birinchi soat ichida empirik antibiotik terapiyani boshlash, keyinchalik mikrobiologik natijalarga asoslanib de-eskalatsiya qilish, infeksiya manbasini bartaraf etish va intensiv terapiya choralarini uyg'unlashtirish muhimligi ko'rsatilgan. Surviving Sepsis Campaign tavsiyalari asosida olib boriladigan "bundle" yondashuvi bemor prognozini yaxshilashda hal qiluvchi ahamiyatga ega ekani qayd etilib, antimikrobial dorilardan oqilona foydalanish sepsisni boshqarishda asosiy strategiyalardan biri sifatida baholangan.*

Kalit so'zlar: *sepsis, bakteriemiya, bakteriologik ekma, prokalsitonin, antibiotik terapiya, intensiv terapiya.*

DIAGNOSTIC APPROACHES AND TREATMENT PRINCIPLES OF BACTERIOLOGICAL SEPSIS

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Abstact. *This article comprehensively presents the relevance of bacteriological sepsis in modern medicine, its pathogenesis, diagnostic approaches, and treatment principles. Sepsis is emphasized as a severe clinical syndrome resulting from a dysregulated host response to infection, characterized by multiple organ dysfunction and high mortality, based on the Sepsis-3 international consensus definition. Gram-negative and Gram-positive bacteria are identified as the primary etiological agents, while the increasing prevalence of antibiotic-resistant strains is highlighted as a significant global concern. The pathogenesis involves activation of the PAMP–TLR signaling pathway leading to a cytokine storm, endothelial injury, microcirculatory dysfunction, and the development of immunoparalysis. Diagnostic strategies include the use of SOFA and qSOFA scoring systems, serum lactate levels, inflammatory biomarkers (CRP, procalcitonin, presepsin), and blood culture as the gold standard method. Given the time-consuming nature of conventional culture-based techniques, the growing importance of rapid culture-independent diagnostic technologies—such as multiplex PCR, FilmArray BCID panels, and emerging metagenomic sequencing—is emphasized. Treatment principles include the initiation of empirical antibiotic therapy within the first hour, followed by de-escalation based on microbiological results, effective source control, and integration of intensive care measures. The "bundle" approach recommended by the Surviving Sepsis Campaign is recognized as a decisive factor in improving patient outcomes, and the rational use of antimicrobial agents is considered one of the fundamental strategies in sepsis management.*

Keywords: *sepsis, bacteremia, blood culture, procalcitonin, antibiotic therapy, intensive care.*

ДИАГНОСТИКА И ПРИНЦИПЫ ЛЕЧЕНИЯ БАКТЕРИОЛОГИЧЕСКОГО СЕПСИСА

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Аннотация. *В данной статье комплексно освещены актуальность бактериологического сепсиса в современной медицине, его патогенез, диагностические подходы и принципы лечения. Подчеркивается, что сепсис представляет собой тяжелый клинический синдром, возникающий вследствие дисрегулированного ответа организма на инфекцию и характеризующийся полиорганной недостаточностью и высокой летальностью, в соответствии с международным консенсусом Sepsis-3. В качестве основных этиологических факторов рассматриваются грамположительные и грамотрицательные бактерии, а также особо отмечается возрастающая распространенность антибиотикорезистентных штаммов как серьезная глобальная проблема. В патогенезе ключевую роль играет активация сигнального пути PAMP–TLR, приводящая к развитию «цитокинового шторма», эндотелиального повреждения, нарушению микроциркуляции и формированию состояния иммунопаралича. В диагностике используются шкалы SOFA и qSOFA, уровень лактата, воспалительные биомаркеры (СРБ, прокальцитонин, пресепсин), а также бактериологический посев крови как «золотой стандарт» подтверждения инфекции. В связи с временными ограничениями традиционных культуральных методов подчеркивается возрастающее значение быстрых некультуральных технологий диагностики, таких как мультиплексная ПЦР, панели FilmArray BCID и перспективные методы метагеномного секвенирования. В лечении важнейшими принципами являются начало эмпирической антибактериальной терапии в течение первого часа, последующая деэскалация на основании микробиологических результатов, своевременный контроль источника инфекции и комплексные мероприятия интенсивной терапии. Подчеркивается, что «bundle»-подход, рекомендованный Surviving Sepsis Campaign, имеет решающее значение для улучшения прогноза пациентов, а рациональное использование антимикробных препаратов рассматривается как одна из ключевых стратегий ведения сепсиса.*

Ключевые слова: *сепсис, бактериемия, гемокультура, прокальцитонин, антибактериальная терапия, интенсивная терапия*

Sepsis infeksiyaga organizmning disrregulyatsiyalangan javobi natijasida yuzaga keladigan, hayot uchun xavfli klinik sindrom bo‘lib, ko‘p a’zoli yetishmovchilik va yuqori o’lim darajasi bilan kechadi. Bakteriologik sepsis qon oqimiga bakterial patogenlarning kirishi bilan bog‘liq bo‘lib, erta tashxis va tezkor, maqsadli davolash choralarini talab qiladi. Sepsis bugungi kunda butun dunyo bo‘ylab sog‘liqni saqlash tizimlari uchun eng jiddiy muammolardan biri hisoblanadi. 2016-yilda e’lon qilingan Uchinchi Xalqaro Konsensus (Sepsis-3) ta’rifiga ko‘ra, sepsis infeksiyaga nisbatan organizmning disrregulyatsiyalangan javobi natijasida yuzaga keladigan va organ disfunktsiyasi bilan kechadigan hayot uchun xavfli holat sifatida belgilanadi. Ushbu ta’rif sepsisni oldingi SIRS-mezonlariga asoslangan yondashuvdan farqli ravishda, organ yetishmovchiligi va prognoz bilan chambarchas bog‘lab berdi [37].

Epidemiologik ma’lumotlarga ko‘ra, sepsis har yili taxminan 49 million kishida uchraydi va 11 milliondan ortiq o‘lim holatlariga sabab bo‘ladi, bu esa global o‘limlarning qariyb 20 foizini tashkil etadi. Ayniqsa, past va o‘rta daromadli mamlakatlarda sepsis bilan bog‘liq o‘lim darajasi yuqori bo‘lib qolmoqda [33]. Klinik amaliyotda sepsis ko‘pincha kech aniqlanadi, bu esa davolashni murakkablashtiradi va o’lim darajasini oshiradi [15].

Bakteriologik sepsis sepsis holatlarining asosiy qismini tashkil etib, qon oqimiga bakterial patogenlarning kirishi va ularning toksinlari bilan bog‘liq yallig‘lanish reaksiyasi bilan tavsiflanadi [35]. Gram-manfiy bakteriyalar (masalan, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*) hamda Gram-musbat mikroorganizmlar (*Staphylococcus aureus*, *Enterococcus spp.*) bakteriologik sepsisning eng ko‘p uchraydigan etiologik omillari hisoblanadi [42]. So‘nggi yillarda antibiotiklarga rezistent shtammlarning ko‘payishi sepsisning klinik boshqaruvini yanada murakkablashtirdi [22].

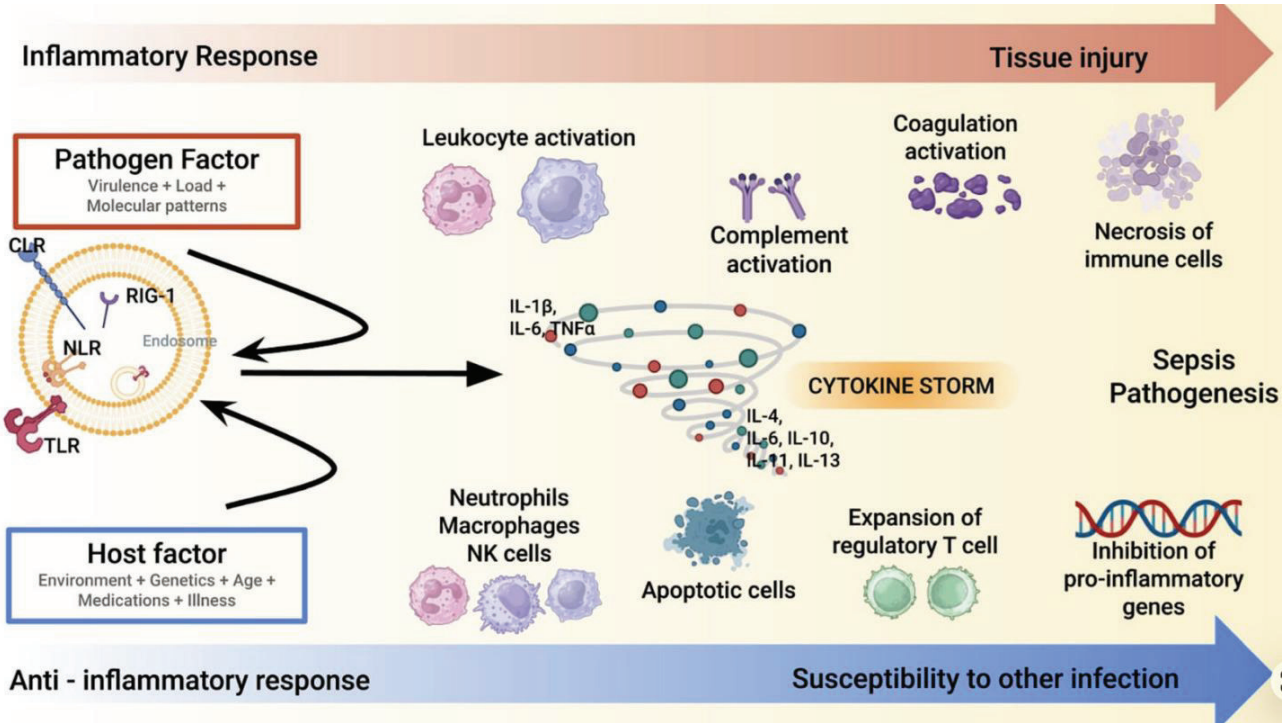
Sepsisda vaqt hal qiluvchi omil hisoblanadi. Kumar va hammualliflar tomonidan o‘tkazilgan yirik kuzatuv tadqiqotida septik shokda samarali antibiotik terapiyasining har bir kechiktirilgan soati o‘lim xavfini o‘rtacha 7–8 foizga oshirishi aniqlangan [20]. Shu sababli sepsisni erta aniqlash va etiologik patogenni imkon qadar tez aniqlab, mos davolashni boshlash zamonaviy tibbiyotning ustuvor vazifalaridan biridir.

Bakteriologik sepsis patogenezi

Bakteriologik sepsis patogenezi murakkab va ko‘p bosqichli jarayon bo‘lib, patogen mikroorganizmlar va mezbon immun tizimi o‘rtasidagi o‘zaro ta’sir natijasida rivojlanadi.

Bakterial hujayra devori komponentlari, xususan lipopolisaxaridlar (LPS), peptidoglikanlar va lipoteixoik kislotalar kabi PAMP (pathogen-associated molecular patterns) strukturalari tug‘ma immunitet retseptorlari — Toll-like retseptorlar (TLR) bilan bog‘lanadi [26]. Ushbu bog‘lanish NF-κB va boshqa signal yo‘llarini faollashtirib, proinflamator sitokinlar, jumladan TNF-α, IL-1β va IL-6 ning keskin ajralishiga olib keladi(1-rasm) [2].

Nazoratdan chiqqan yallig‘lanish reaksiyasi endotelial disfunktsiya, kapillyar o‘tkazuvchanlikning oshishi va mikrosirkulyatsiya buzilishlariga sabab bo‘ladi [19]. Natijada to‘qimalarda gipoksiya, metabolik asidoz va ko‘p a’zoli yetishmovchilik rivojlanadi [17]. Shu bilan birga, sepsisda yallig‘lanishga qarshi mexanizmlar (masalan, IL-10 sekretsiyasi) ham faollashadi, bu esa immunparalich holatiga olib kelib, ikkilamchi infeksiyalar xavfini oshiradi [18].



1-rasm. **Sepsis rivojlanishining immunopatogenetik mexanizmi**

Diagnostika yondashuvlarining umumiy tamoyillari.

Bakteriologik sepsis diagnostikasi klinik baholash, laborator tekshiruvlar va mikrobiologik tasdiqlashning kombinatsiyasiga asoslanadi. Sepsis-3 mezonlariga muvofiq, SOFA ballining kamida 2 birlikka oshishi sepsis mavjudligini ko‘rsatadi [37]. Klinik amaliyotda qSOFA balli (arterial bosim ≤100 mmHg, nafas soni ≥22/min va ong buzilishi) sepsisni tezkor skrining qilish vositasi sifatida qo‘llaniladi, biroq u diagnostik test emas, balki xavfni baholash usuli hisoblanadi [36].

Laborator ko‘rsatkichlar orasida laktat darajasining oshishi to‘qima gipoperfuziyasi va yomon prognoz bilan bog‘liq bo‘lib, sepsisni baholashda muhim ahamiyatga ega [8]. Shu bilan birga, etiologik tashxisni aniqlashda mikrobiologik usullar, xususan qonning bakteriologik ekmasi va zamonaviy molekulyar texnologiyalar markaziy o‘rin tutadi [21].

Qon bakteriologik ekmasi va bakteriologik tasdiqlash

Qon bakteriologik ekmasi bakteriologik sepsis diagnostikasida oltin standart bo‘lib qolmoqda, chunki u patogenni bevosita aniqlash va antibiotiklarga sezuvchanligini baholash imkonini beradi [28]. Amaldagi tavsiyalarga ko‘ra, antibiotik terapiya boshlanishidan oldin kamida ikki juft qon bakteriologik ekmasi olinishi lozim [31]. Biroq qon bakteriologik ekmasining sezuvchanligi cheklangan bo‘lib, u ko‘pincha 30–60% ni tashkil etadi, ayniqsa bemor avval antibiotik qabul qilgan bo‘lsa [32].

Biomarkerlar va laborator ko‘rsatkichlarning roli

Bakteriologik sepsisda laborator biomarkerlar klinik baholashni qo‘llab-quvvatlovchi muhim vositalardan biri bo‘lib, ular infeksiyaning og‘irligi, prognozi va davolashga javobni baholashda yordam beradi. Laktat darajasi sepsisda to‘qimalar gipoperfuziyasi va anaerob metabolizmning kuchayishini aks ettiradi hamda yomon prognoz bilan bog‘liq hisoblanadi [8]. Tadqiqotlar shuni ko‘rsatadiki, dastlabki laktat darajasining ≥2 mmol/L bo‘lishi va uning reanimatsiya jarayonida pasaymasligi o’lim darajasining oshishi bilan uzviy bog‘liq [27]. Shu sababli laktatni dastlab va davolash jarayonida qayta o‘lchash Surviving Sepsis Campaign tavsiyalarida muhim komponent sifatida kiritilgan [14].

Yallig‘lanish markerlari orasida C-reaktiv oqsil (CRP) keng qo‘llaniladi, biroq uning spetsifikligi past bo‘lib, bakterial va nobakterial yallig‘lanishlarni aniq farqlash imkonini bermaydi [30]. Prokalsitonin (PCT) esa bakterial infeksiyalarda sezilarli darajada oshishi bilan ajralib turadi va virusli infeksiyalarga nisbatan yuqori diagnostik qiymatga ega [6]. Metatahlillar PCT-ga asoslangan antibiotik strategiyalari antibiotik terapiya davomiyligini qisqartirishini va o’lim darajasining oshirmasligini ko‘rsatgan [34]. Shu bilan birga, PCT mutlaq diagnostik test emasligi, balki klinik kontekst bilan birgalikda talqin qilinishi lozimligi ta’kidlanadi [42].

So‘nggi yillarda yangi biomarkerlar, jumladan monositlar hajmi tarqalish kengligi (MDW), presepsin (sCD14-ST) va interleykin-6 kabi ko‘rsatkichlar

sepsisni erta aniqlash imkoniyatlari nuqtai nazaridan o‘rganilmoqda [11,39]. Presepsin darajasining oshishi bakteriemiya va sepsis bilan kuchli bog‘liqligi aniqlangan bo‘lsa-da, ushbu markerlarning klinik amaliyotdagi o‘rni hali to‘liq standartlashtirilmagan [39].

Molekulyar va tezkor mikrobiologik diagnostika

An’anaviy qon bakteriologik ekmasi natijalari 24–72 soat vaqt talab qilishi sababli, sepsisda tezkor molekulyar diagnostika usullariga ehtiyoj ortib bormoqda. Multipleks polimeraza zanjir reaksiyasi (PCR) asosidagi tizimlar bir vaqtning o‘zida bir nechta patogenlarni aniqlash imkonini berib, diagnostika vaqtini sezilarli darajada qisqartiradi [10]. Tsalik va hamkasblari o‘tkazgan tadqiqotda multipleks PCR yordamida qon oqimi infeksiyalarini aniqlash an’anaviy bakteriologik ekma nisbatan tezroq va yuqori aniqlik bilan amalga oshirilganligi ko‘rsatilgan [38].

Qon baketriologik ekmasi ijobiy namunalarida qo‘llaniladigan FilmArray Blood Culture Identification (BCID) panellari(2-rasm) patogenni va ayrim antibiotik rezistentlik genlarini 1–2 soat ichida aniqlash imkonini beradi [1]. Klinik tadqiqotlar ushbu texnologiyalar empirik antibiotik terapiyani tezroq kamaytirishga yordam berishini va antimikrobial dorilardan oqilona foydalanish samaradorligini oshirishini ko‘rsatgan [4]. Shunga qaramay, molekulyar testlar ko‘pincha antibiotik sezuvchanligini to‘liq aniqlab bermasligi sababli, ularni klassik qon bakteriologik ekmasi va fenotipik testlar bilan birgalikda qo‘llash tavsiya etiladi [25].



2-rasm. **FilmArray Blood Culture Identification (BCID) panellari**

Empirik va maqsadli antibakterial terapiya

Bakteriologik sepsisni davolashda empirik antibiotik terapiya iloji boricha tez, ideal holda tashxis gumoni paydo bo‘lganidan keyin birinchi soat ichida boshlanishi lozim [20,14]. Empirik preparatlar tanlovi ehtimoliy patogenlar, infeksiya manbai, bemorning klinik holati va mahalliy antibiotik rezistentlik ma’lumotlariga asoslanishi kerak [5]. Og‘ir sepsis va septik shokda keng spektrli beta-laktam antibiotiklar (masalan, piperatsillin/tazobaktam yoki karbapenemlar) ko‘pincha glukopeptidlar yoki oksazolidinonlar bilan kombinatsiyada qo‘llaniladi [29].

Mikrobiologik natijalar olingach, antibiotik terapiya imkon qadar toraytirilishi va maqsadli preparatga o‘tkazilishi lozim, bu esa toksiklik va antibiotik rezistentlik rivojlanish xavfini kamaytiradi [13]. Tadqiqotlar de-eskalatsiya strategiyalari klinik natijalarga salbiy ta’sir ko‘rsatmasdan, antibiotik yuklamasini kamaytirishini ko‘rsatgan [12]. Davolash davomiyligi infeksiya manbai va klinik javobga bog‘liq bo‘lib, ko‘p hollarda 7–10 kunni tashkil etadi, biroq ayrim holatlarda qisqaroq kurslar ham yetarli bo‘lishi mumkin [44].

Manba nazorati va intensiv terapiya tamoyillari

Sepsisda infeksiya manbasini bartaraf etish davolashning ajralmas qismi hisoblanadi. Jarrohlik yoki invaziv muolajalar yordamida absessni drenaj qilish, nekrotik to‘qimalarni olib tashlash yoki infektsiyalangan kateterlarni chiqarish bemor prognozini sezilarli yaxshilaydi [24]. Kechiktirilgan manba nazorati mortalitetning oshishi bilan bog‘liqligi ko‘plab klinik tadqiqotlarda tasdiqlangan [3].

Intensiv terapiyada suyuqlik reanimatsiyasi, vazopressorlar va organlarni qo‘llab-quvvatlash muhim ahamiyatga ega. Dastlabki 30 ml/kg kristalloid eritma bilan suyuqlik reanimatsiyasi arterial bosimni barqarorlashtirishga yordam beradi, ammo suyuqlik ortiqcha yuklanishining oldini olish uchun individual yondashuv talab etiladi [14]. Norepinefrin septik shokda birinchi tanlov vazopressori hisoblanadi [41].

Surviving Sepsis Campaign tavsiyalari asosida kompleks yondashuv

Bakteriologik sepsisni boshqarishda xalqaro **Surviving Sepsis Campaign (SSC)** tavsiyalari klinik amaliyot uchun asosiy yo‘riqnoma bo‘lib xizmat qiladi. 2021-yilda yangilangan SSC ko‘rsatmalarida sepsisni erta aniqlash, tezkor antibiotik terapiya, suyuqlik reanimatsiyasi va organlarni qo‘llab-quvvatlash choralarining uyg‘unligi asosiy tamoyil sifatida belgilangan [14]. Ushbu tavsiyalar sepsisni “vaqtga bog‘liq kasallik” sifatida ko‘rib, dastlabki soatlarda amalga oshiriladigan choralar bemor prognoziga hal qiluvchi ta’sir ko‘rsatishini ta’kidlaydi [14].

SSC ko‘rsatmalariga ko‘ra, sepsis gumon qilingan har bir bemorda dastlabki baholash bilan bir vaqtda qon bakteriologik ekmasi olinishi va antibiotik terapiya kechiktirilmasdan boshlanishi kerak [14]. Shuningdek, laktat darajasini o‘lchash va gipoperfuziya belgilari mavjud bo‘lsa, suyuqlik reanimatsiyasini darhol boshlash tavsiya etiladi [8,14]. Ushbu “bundle” yondashuvi klinik tadqiqotlarda o’lim darajasining pasayishi bilan bog‘liqligi ko‘rsatilgan [23].

Antimikrobial dorilardan oqilona foydalanish va antibiotik rezistentlik muammosi

So‘nggi yillarda antibiotiklarga rezistent bakterial shtammlarning keng tarqalishi bakteriologik sepsis davolashini murakkablashtirmoqda. ESBL ishlab chiqaruvchi Enterobacterales, karbapenemga rezistent *Klebsiella pneumoniae* va MRSA kabi patogenlar sepsis holatlarida tobora ko‘proq aniqlanmoqda [9]. Shu sababli empirik antibiotik tanlashda mahalliy rezistentlik ma’lumotlari va bemorning individual xavf omillari hisobga olinishi zarur [5].

Antimikrobial doirlardan oqilona foydalanish dasturlari sepsisni boshqarishda muhim ahamiyatga ega bo‘lib, ular bir tomondan erta va yetarli empirik terapiyani ta’minlashni, ikkinchi tomondan esa maqsadli davolashga o‘z vaqtida o‘tishni nazarda tutadi [13]. Tadqiqotlar dorilardan oqilona foydalanish yondashuvlari antibiotiklarni noo‘rin qo‘llashni kamaytirishini va klinik natijalarga salbiy ta’sir ko‘rsatmasligini ko‘rsatgan [12]. Molekulyar tezkor diagnostika usullarining joriy etilishi dorilardan oqilona foydalanish samaradorligini oshirib, antibiotik de-eskalatsiyasini tezlashtirish imkonini bermoqda [4].

Kelajakdagi diagnostika va davolash yo‘nalishlari

Bakteriologik sepsis diagnostikasida kelajakda qonning bakteriologik ekmalarisiz (culture-independent) texnologiyalar muhim o‘rin egallashi kutilmoqda. Metagenomik yangi avlod sekvensiyasi (NGS) usullari qon namunalaridan to‘g‘ridan-to‘g‘ri patogen DNKsini aniqlash imkonini berib, qon bakteriologik ekmasi manfiy bo‘lgan holatlarda ham etiologik tashxis qo‘yishga yordam beradi [16]. Dastlabki tadqiqotlar ushbu texnologiyalar yuqori sezuvchanlikka ega ekanligini ko‘rsatgan bo‘lsa-da, ularning keng klinik amaliyotga joriy etilishi uchun xarajat va standartlashtirish masalalari hal etilishi lozim [7].

Davolash sohasida esa individualizatsiyalangan yondashuvlar, xususan immunomodulyator terapiyalar va bemorning immun fenotipiga asoslangan strategiyalar o‘rganilmoqda [40]. Sepsisda immun javobning giperinflamator va immunparalitik fazalari mavjudligi sababli, kelajakda terapiya ushbu bosqichlarga moslashtirilgan bo‘lishi mumkin [18,40].

Xulosa.

Bakteriologik sepsis yuqori o’lim darajasi va murakkab klinik kechishi bilan tavsiflanadigan og‘ir holat bo‘lib, uning muvaffaqiyatli boshqaruvi erta tashxis va kompleks davolash choralariga bog‘liq. Qon bakteriologik ekmasi va zamonaviy molekulyar diagnostika usullari etiologik tashxisni aniqlashda muhim ahamiyatga ega bo‘lib, biomarkerlar klinik baholashni qo‘llab-quvvatlaydi. Empirik antibiotik terapiyani o‘z vaqtida boshlash, manba nazorati va intensiv terapiya choralarini uyg‘unlashtirish bemor prognozini yaxshilaydi. Antimikrobial dorilardan oqilona foydalanish va yangi diagnostik texnologiyalar sepsisni boshqarishda kelajakdagi asosiy yo‘nalishlar sifatida qaralmoqda.

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