

Article/Review

Murakkab teri orqali koronar aralashuvda tomir ichi vizualizatsiyasi va fiziologik baholash usullarining roli: sistematik adabiyotlar sharhi

B.A. Yo'ldashov *¹ , X.G'. Fozilov ¹ , B.R. Atamuratov ¹ 

¹ Yurak-qon tomir kasalliklarini rentgen-endovaskulyar davolash bo'limi, Respublika ixtisoslashtirilgan kardiologiya ilmiy-amaliy tibbiyot markazi, Toshkent, 100052, O'zbekiston

hurshidfozilov1976@icloud.com (X.F.), ybaxtiyorjon@gmail.com (B.Y.), baxtiyor-cardio@mail.ru (B.A.)

* Correspondence: ybaxtiyorjon@gmail.com; Tel.: +998 91 163 25 29 (B.Y.)

Annotatsiya: Ushbu sistematik adabiyotlar sharhida murakkab teri orqali koronar aralashuv (TOKA) amaliyotlarida tomir ichi vizualizatsiyasi (IVUS, OKT) va fiziologik baholash usullarining (FFR, iFR) diagnostik va klinik ahamiyati tahlil qilingan. **Maqsad.** Murakkab koronar zararlanishlarda tomir ichi vizualizatsiyasi va fiziologik baholash usullarining TOKA natijalariga ta'sirini sistematik ravishda baholash. **Material va usullar.** 2009–2025 yillarda PubMed, Scopus, Web of Science va Google Scholar ma'lumotlar bazalarida chop etilgan 39 ta ilmiy manba, jumladan RENOVATE-COMPLEX-PCI, ULTIMATE, ILUMIEN IV, FAME 1–3, DEFINE-FLAIR va iFR-SWEDEHEART kabi yirik randomizatsiyalashtirilgan klinik tadqiqotlar, meta-tahlillar va xalqaro konsensus hujjatlari tahlil qilingan. **Natijalar.** Tomir ichi vizualizatsiyasi (IVUS yoki OKT) yo'riqnomasi bilan o'tkazilgan TOKA, an'anaviy angiografiyaga qaraganda 2 yillik MACE darajasini 28% ga kamaytirishi aniqlangan (HR 0,72; 95% CI 0,62–0,85). FFR va iFR yo'riqnomali TOKA strategiyalari o'zaro ekvivalent natijalarni ko'rsatgan. Murakkab TOKA sharoitida intravascular imaging bilan o'tkazilgan amaliyotlarda birlamchi yakuniy nuqta 7,7% ni, angiografiya guruhida esa 12,3% ni tashkil etgan (HR 0,64; p=0,008). **Xulosa.** Murakkab koronar zararlanishlarda tomir ichi vizualizatsiyasi va fiziologik baholash usullarini qo'llash klinik natijalarni sezilarli yaxshilaydi va zamonaviy yo'riqnomalarda yuqori darajadagi tavsiya sifatida belgilangan.

Kalit so'zlar: murakkab teri orqali koronar aralashuv; tomir ichi ultratovush tekshiruvi; optik kogerens tomografiya; fraksion oqim zaxirasi; lahzali to'liqsiz nisbat; koronar arteriya kasalligi; intravascular imaging.

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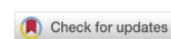
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The role of intravascular imaging and physiological assessment in complex percutaneous coronary intervention: a systematic literature review

Bakhtiyor A.Yuldashov *¹ , Khurshid G.Fozilov ¹ , B.R. Atamuratov ¹ 

¹ Department of X-ray Endovascular Treatment of Cardiovascular Diseases, Republican Specialized Scientific and Practical Medical Center of Cardiology, Tashkent, 100052, Uzbekistan

hurshidfozilov1976@icloud.com (Kh.F.), ybaxtiyorjon@gmail.com (B.Y.), baxtiyor-cardio@mail.ru (B.A.)

Abstract:

This systematic literature review analyzes the diagnostic and clinical significance of intravascular imaging (IVUS, OCT) and physiological assessment methods (FFR, iFR) in complex percutaneous coronary intervention (PCI) procedures. **Aim.** To systematically evaluate the impact of intravascular imaging and physiological assessment on outcomes of complex PCI. **Methods.** A systematic search of 39 scientific sources published between 2009 and 2025 was conducted using PubMed, Scopus, Web of Science, and Google Scholar databases, including major randomized controlled trials (RENOVATE-COMPLEX-PCI, ULTIMATE, ILUMIEN IV, FAME 1–3, DEFINE-FLAIR,

iFR-SWEDEHEART), meta-analyses, and international consensus documents. **Results.** Intravascular imaging-guided (IVUS or OCT) PCI reduced 2-year MACE by 28% compared to angiography guidance (HR 0.72; 95% CI 0.62–0.85). FFR- and iFR-guided PCI strategies demonstrated equivalent outcomes. In complex PCI settings, imaging-guided procedures achieved a primary endpoint of 7.7% versus 12.3% in the angiography group (HR 0.64; $p=0.008$). **Conclusion.** The application of intravascular imaging and physiological assessment in complex coronary lesions significantly improves clinical outcomes and is recommended at the highest evidence level in contemporary guidelines.

Keywords: complex percutaneous coronary intervention; intravascular ultrasound; optical coherence tomography; fractional flow reserve; instantaneous wave-free ratio; coronary artery disease; intravascular imaging.

Kirish

Yurak-qon tomir kasalliklari bugungi kunda dunyodagi asosiy o'lim sabablari orasida birinchi o'rinni egallaydi. Jahon Sog'liqni Saqlash Tashkiloti ma'lumotlariga ko'ra, har yili 17,9 million kishi yurak-qon tomir kasalliklaridan vafot etadi, bu barcha o'limlarning 31% ini tashkil qiladi [1]. Yurak ishemik kasalligi (YuIK)ni zamonaviy davolashda teri orqali koronar aralashuv (TOKA) tibbiyotining eng jadal rivojlanayotgan yo'nalishlaridan biri hisoblanadi. So'nggi o'n yillikda intervension kardiologiya amaliyotida murakkab TOKA tushunchasi keng qo'llanila boshlandi [2]. 2024-yilda nashr etilgan Yevropa Kardiologlar Jamiyati (ESC) ning surunkali koronar sindromlarni boshqarish bo'yicha yangilangan klinik yo'riqnomalarida anatomik murakkab zararlanishlarda TOKA, tomir ichi ultratovush tekshiruvi (IVUS) yoki optik kogerens tomografiya (OKT) nazorati ostida amalga oshirish - I sinf, A darajali dalillar asosida tavsiya etiladi [3]. Mazkur yondashuv zamonaviy kardiologiyada intravaskulyar tasvirlash usullarining naqadar muhim ahamiyatga ega ekanligini tasdiqlaydi.

Giustino va hammualliflarining 2016-yilda Journal of American College of Cardiology nashrida chop etilgan fundamental tadqiqotida, 14 993 nafar bemorni qamrab olgan uchta klinik sinovning individual ma'lumotlari meta-tahlili asosida murakkab TOKAning standartlashtirilgan ta'rifi ishlab chiqildi. Mazkur ta'rifga ko'ra, quyidagi 6 ta mezonlardan kamida bittasi mavjud bo'lgan holatlar murakkab TOKA deb tasniflanadi: 3 va undan ortiq tomirga aralashuv o'tkazish, 3 va undan ortiq stent implantatsiyasi, 3 va undan ortiq zararlanish o'chog'ini davolash, bifurkatsion zararlanishlarni ikki stentli usulda stentlash, stentning umumiy uzunligi >60 mm bo'lishi yoki surunkali to'liq okklyuziya (STO) mavjudligi [4]. Giustino tadqiqoti natijalariga ko'ra, murakkab TOKA o'tkazilgan bemorlarda 1 yillik yirik noxush qon-tomir hodisalar (MACE) ko'rsatkichi 10,1%, standart TOKA guruhida esa 5,0% tashkil etgan (HR 1,98; 95% CI 1,74–2,26; $p<0,001$) [4]. Kinnaird va uning hamkasblarining Buyuk Britaniya Intervension Kardiologiya Jamiyati (BCIS) ma'lumotlar bazasi tahliliga asoslangan tadqiqoti 2006–2016-yillar davomida bajarilgan 514 575 ta TOKA amaliyotini qamrab oldi va murakkab TOKAning kengaytirilgan mezonlarini taqdim etdi [5]. Mazkur mezonlar qatoriga chap koronar arteriyaning himoyalangan asosiy o'zani (unprotected LMCA), safena vena graftlari, uzunligi ≥ 30 mm bo'lgan zararlanishlar va kuchli kalsinatsiyalangan zararlanishlar kiritilgan.

O'zbekiston Respublikasi tibbiyot muassasalarida ham TOKA va endovaskulyar davolash usullari faol joriy etilmoqda. Fozilov va hammualliflarining 2023-yilda « » jurnalida chop etilgan tadqiqotida O'zbekiston RIKIATM DM ga surunkali yurak yetishmovchiligi tashxisi bilan yotqizilgan bemorlarning klinik xususiyatlari tahlil qilingan bo'lib, gospitalizatsiya qilingan bemorlarning ko'pchiligida YuIK surunkali yurak yetishmovchiligining asosiy etiologik omili sifatida aniqlangan [6]. 2024-yilda Kardiologiya jurnalida chop etilgan yana bir tadqiqotida Orol dengizi hududida 40 yoshdan oshgan aholi orasida yurak-qon tomir kasalliklari xavf omillarini erta aniqlash bo'yicha skrining natijalari tahlil qilingan [7]. Bundan tashqari, 2023-yilda Frontiers in Genetics jurnalida nashr etilgan tadqiqotida koronar arteriya kasalligi va oilaviy giperxolesterinemiya bo'lgan bemorlarda PCSK9 geni E670G polimorfizmining klinik ahamiyati o'rganilgan [8].

Ushbu sistematik adabiyotlar sharhining maqsadi - murakkab koronar zararlanishlarda tomir ichi vizualizatsiyasi (IVUS, OKT) va fiziologik baholash usullari (FFR, iFR)ning TOKA natijalariga ta'sirini zamonaviy dalillar asosida sistematik ravishda baholashdir.

1. Murakkab TOKA tushunchasi va standartlashtirilgan mezonlari

Murakkab TOKA - bu yuqori protsedural xavf va yirik noxush hodisalar ehtimoli oshgan endovaskulyar koronar aralashuv turlari umumiy nomidir. Giustino va hamkasblarining 2016-yilgi ADAPT-DES, HORIZONS-AMI va ACUITY tadqiqotlarining 14 993 ta bemorini qamrab olgan individual bemor ma'lumotlari meta-tahlili murakkab TOKAning oltita asosiy mezonini aniqladi: (1) uch yoki undan ortiq tomirni davolash; (2) uch yoki undan ortiq stent implantatsiyasi; (3) uch yoki undan ortiq zararlanish o'chog'ini davolash; (4) bifurkatsion zararlanishlarni ikki stentli usulda stentlash; (5) umumiy stent uzunligi >60 mm; (6) surunkali to'liq okluziya (STO) mavjudligi [4]. Bu ta'rif 2017-yilda Yevropa Kardiologlar Jamiyati tomonidan ikki tomonlama antitrombotik terapiya (DAPT) bo'yicha ko'rsatmalarga kiritildi. Levine va uning hamkasblarining ACC/AHA tomonidan ishlab chiqilgan DAPT muddati bo'yicha 2016-yilgi yangilangan ko'rsatmalarida ham murakkab TOKA mezonlari hisobga olingan [9]. Riley va hammualiflarining 2020-yilda SCAI nomidan e'lon qilingan bayonotida ta'kidlanishicha, CHIP-PKA (yuqori xavfli va murakkab TOKA) tushunchasi bemor uchun xos omillar (keksa yosh, chap qorinchaning og'ir disfunktsiyasi, surunkali buyrak kasalligi) hamda amaliyotga aloqador omillarni inobatga oladi [10].

Rossiya Federatsiyasida 2022-yilda 291 370 ta TOKA amalga oshirildi, bu 2021-yilga nisbatan 10,2% ga ko'p [11]. SYNTAX shkalasi koronar arteriya kasalligida anatomik murakkablik darajasini miqdoriy baholashning muhim vositasi hisoblanadi. Farooq va hammualiflarining 2017-yilda JACC nashrida chop etilgan tadqiqotiga ko'ra, SYNTAX shkalasidagi har 10 ballik o'sish o'lim xavfining 15% ga ortishiga olib kelishi aniqlangan (HR 1,15; 95% CI 1,08–1,23; $p<0,001$) [12]. Hara va hammualiflarining 2021-yilda JACC jurnalida chop etilgan tadqiqotida SYNTAX Score II 2020 tizimining tashqi validatsiyasi (external validation) 12 977 nafar bemor ma'lumotlari asosida amalga oshirildi [13]. **2. Koronar angiografiyaning cheklangan jihatlari va tomir ichi vizualizatsiyasiga ehtiyoj**

Uzoq yillar davomida koronar angiografiya - YuK tashxislashda «oltin standart» sifatida e'tirof etib kelinmoqda. Shunga qaramay, angiografiya ikki o'lchamli (2D) proyeksiyaga asoslangani bois, u koronar arteriyaning haqiqiy anatomik tuzilishini, aterosklerotik tugunchalar (plaklar) tarkibini va stenozning funksional ahamiyatini to'liq yoritib berish imkoniyatiga ega emas. Raber va hamkasblarining 2018-yilda European Heart Journal jurnalida nashr etilgan EAPCI konsensus hujjati tomir ichi vizualizatsiyaning klinik qo'llanilishini taqdim etdi va angiografiyaning asosiy cheklanishlarini batafsil bayon qildi [14]. Johnson va hamkasblarining 2019-yilda e'lon qilingan EAPCI konsensus hujjatining ikkinchi qismida alohida qayd etilganidek, angiografiya usuli aterosklerotik tugunchalar tarkibi, kalsifikatsiya darajasi, stent malappozitsiyasi hamda tomir disseksiyasi kabi klinik jihatdan muhim parametrlarni to'liq vizualizatsiya qilish imkoniyatiga ega emas [15]. **3. Tomir ichi ultratovush tekshiruv (IVUS): texnika, mezonlar va klinik qo'llanishi**

IVUS tekshiruv usuli ultratovush to'lqinlariga asoslangan bo'lib, u koronar arteriyaning real vaqt rejimida tasvirlash imkonini beradi. IVUSning fazoviy aniqligi $100\text{--}150\text{ }\mu\text{m}$ ni, to'lqinning to'qimalarga penetratsiya chuqurligi esa $4\text{--}8\text{ mm}$ ni tashkil etadi [14,15]. CVIT (Yaponiya Kardiovaskulyar Intervensiya va Terapiya Assotsiatsiyasi) 2025-yilgi klinik ekspert konsensus hujjati IVUS o'lchash va baholash standartlarini batafsil bayon qiladi [16]. LMCA uchun IVUS mezonlari alohida ahamiyatga ega. Case va hamkasblarining 2020-yilda International Journal of Cardiology jurnalida nashr etilgan sharh maqolasiga ko'ra, LMCA uchun $\text{MLA} \leq 6,0\text{ mm}^2$ $\text{FFR} \leq 0,80$ bilan korrelyatsiya qiluvchi kesish nuqtasi hisoblanadi. Osiyo populyatsiyasi uchun biroz past kesish nuqtalari ($4,5\text{--}4,8\text{ mm}^2$) tavsiya etilishi mumkin [17].

ULTIMATE tadqiqotining (2018, $n=1448$) 3 yillik kuzatuv natijalari 2021-yilda JACC Cardiovascular Interventions jurnalida nashr etildi. Natijalarga ko'ra, 3 yillik TVF IVUS guruhida 4,0% ni, angiografiya guruhida esa 8,1% ni tashkil qildi (HR 0,48; 95% CI 0,32–0,73; $p<0,001$) [18,19]. 2015-yilda JAMA jurnalida chop etilgan IVUS-XPL tadqiqoti 1400 nafar bemorni qamrab oldi. Hong, Kim, Shin va hammualiflari tomonidan Koreya Respublikasida o'tkazilgan mazkur tadqiqotda, uzun koronar zararlanishlarda (stent uzunligi $\geq 28\text{ mm}$) IVUS nazorati ostida everolimus ajratuvchi stentlarni implantatsiya qilish samaradorligi baholandi. Bir yillik birlamchi yakuniy nuqta ko'rsatkichi IVUS guruhida 2,9% ni, faqat angiografiya nazorati ostidagi guruhda esa 5,8% ni tashkil etdi (HR 0,48; 95% CI 0,28–0,83; $p=0,007$) [20]. IVUS-XPL tadqiqotining 5 yillik kuzatuv natijalarida esa 5 yillik MACE darajasi IVUS guruhida 5,6% ni, angiografiya guruhida esa 10,7% ni tashkil qildi (HR 0,50; 95% CI 0,32–0,80; $p=0,004$) [21].

RENOVATE-COMPLEX-PCI tadqiqoti (2023) murakkab TOKA sharoitida tomir ichi vizualizatsiyasi yo'riqnomasining ustunligini tasdiqlagan eng yirik randomizatsiyalashtirilgan tadqiqot hisoblanadi. Lee va hamkasblari tomonidan Koreya Respublikasida amalga oshirilgan ushbu tadqiqot 1639 ta bemorni o'z ichiga oldi. Ikki yillik kuzatuv natijalariga ko'ra, birlamchi yakuniy nuqta ko'rsatkichi tomir ichi vizualizatsiyasi guruhida 7,7% ni, standart angiografiya guruhida esa 12,3% ni tashkil etdi (HR 0,64; 95% CI 0,45–0,89; p=0,008) [22]. **4. Optik kogerens tomografiya (OKT): yuqori aniqlik va klinik qo'llanishi**

Optik kogerens tomografiya (OKT) infraqizil nurlanishdan foydalangan holda koronar arteriyalar devorining o'ta yuqori aniqlikdagi tasvirini olish imkonini beradi. OKTning fazoviy aniqligi (rezolyutsiyasi) 10–15 mkm ni tashkil etadi, bu IVUS ko'rsatkichiga nisbatan 10 barobar yuqoridir. Biroq, OKTning to'qimalarga penetratsiya chuqurligi cheklangan bo'lib, atigi 1–2 mm ni tashkil qiladi [23,24].

ILUMIEN III tadqiqoti (2016, Lancet) 450 ta bemorni o'z ichiga oldi. Tadqiqot shuni ko'rsatdiki, minimal ichki tomir bo'shlig'i maydoni OCT guruhida 5,79 mm², IVUS guruhida 5,89 mm², angiografiya guruhida esa 5,49 mm² ni tashkil qildi. OCT va IVUS o'rtasida statistik jihatdan ahamiyatli farq aniqlanmadi (p=0,12), biroq har ikki vizualizatsiya usuli ham angiografiyaga nisbatan statistik ishonchli ustunlikka ega ekanligi namoyon etildi [23]. ILUMIEN IV tadqiqoti (2023) - New England Journal of Medicine jurnalida nashr etilgan eng yirik OCT tadqiqoti hisoblanadi. Ali, Landmesser, Maehara va hamkasblari tomonidan 2487 ta bemorni o'z ichiga olgan ushbu tadqiqot OCT yo'riqnomasi bilan TOKA va angiografiya yo'riqnomasi bilan TOKA ni taqqosladi. 2 yillik MACE OCT guruhida 7,4% ni, angiografiya guruhida esa 10,5% ni tashkil qildi (HR 0,70; 95% CI 0,54–0,90; p=0,006) [24].

OCTIVUS tadqiqoti (2023, Circulation) 1201 ta bemorni o'z ichiga oldi. Kang va hammualiflari tomonidan Koreya Respublikasida amalga oshirilgan mazkur tadqiqot OKT va IVUS nazorati ostidagi muolajalarni o'zaro bevosita qiyoslagan birinchi yirik randomizatsiyalangan klinik tekshiruv hisoblanadi. Ikki yillik kuzatuvdagi birlamchi yakuniy nuqta ko'rsatkichlari OKT guruhida 10,1% ni, IVUS guruhida esa 8,5% ni tashkil etdi (HR 1,18; 95% CI 0,85–1,64; p=0,32). Ushbu natijalar OKT va IVUS usullarining klinik samaradorlik jihatidan o'zaro ekvivalent ekanligini tasdiqladi [25].

Table 1. Tomir ichi vizualizatsiyasiga oid asosiy klinik tadqiqotlar va ularning natijalari.

Jadval 1. Murakkab va yuqori xavfli TOKAda IVUS/OKT yo'riqnomasining klinik dalillari.

Tadqiqot	n	Taqqoslash	Asosiy natija
ULTIMATE [18,19]	1448	IVUS vs angiografiya	3 yillik TVF: 4.0% vs 8.1%; HR 0.48, 95% CI 0.32–0.73.
IVUS-XPL [20,21]	1400	IVUS vs angiografiya	5 yillik MACE: 5.6% vs 10.7%; HR 0.50, 95% CI 0.32–0.80.
RENOVATE-COMPLEX-PCI [22]	1639	IVUS/OKT vs angiografiya	2 yillik birlamchi yakuniy nuqta: 7.7% vs 12.3%; HR 0.64, 95% CI 0.45–0.89.
ILUMIEN III [23]	450	OKT vs IVUS vs angiografiya	Minimal stent maydoni OKT va IVUS guruhlarida o'xshash, ikkala imaging strategiyasi angiografiyaga nisbatan protsedural optimallashtirishni yaxshilagan.
ILUMIEN IV [24]	2487	OKT vs angiografiya	2 yillik MACE: 7.4% vs 10.5%; HR 0.70, 95% CI 0.54–0.90.
OCTIVUS [25]	1201	OKT vs IVUS	2 yillik birlamchi yakuniy nuqta: 10.1% vs 8.5%; HR 1.18, 95% CI 0.85–1.64.

5. Fraksion oqim zaxirasi (FFR): funksional baholashning «oltin standarti»

Fraksion oqim rezervi (FFR) - koronar stenozning funksional ahamiyatini baholashda «oltin standart» hisoblanadi. FFR ko'rsatkichi maksimal giperemiya sharoitida stenozdan distal qismdagi o'rtacha bosimning (Pd) aortadagi o'rtacha bosimga (Pa) bo'lgan nisbati sifatida aniqlanadi. FFR qiymatining $\leq 0,80$ bo'lishi gemodinamik jihatdan ahamiyatli (ishemiya chaqiruvchi) stenozdan dalolat beradi. FAME tadqiqoti (2009, n=1005) FFR yo'riqnomasi bilan TOKA ning afzalliklarini birinchi marta katta miqdordagi RCTda ko'rsatdi. 1 yillik asosiy hodisalar (o'lim, MI yoki takroriy revaskulyarizatsiya) FFR guruhida 13,2% ni, angiografiya guruhida esa 18,3% ni tashkil qildi (p=0,02) [26].

FAME 2 tadqiqoti (2012, n=888) barqaror koronar arteriya kasalligida FFR yo'riqnomasi bilan TOKA va konservativ terapiyani taqqoslashdi. Tadqiqot muddatidan oldin to'xtatildi, chunki FFR-PCI guruhida shoshilinch revaskulyarizatsiya zaruriyati sezilarli darajada past edi [27]. FAME 2 tadqiqotining 5 yillik kuzatuv natijalari shuni ko'rsatdiki, FFR-PCI guruhida shoshilinch revaskulyarizatsiya 8,1% ni, konservativ terapiya guruhida esa 19,5% ni tashkil qildi (HR 0,39; 95% CI 0,26–0,57; $p<0,001$) [28]. FAME 3 tadqiqoti (2022, n=1500) uch tomirli koronar arteriya kasalligida FFR nazorati ostidagi TOKA va AKSh amaliyotlarini o'zaro taqqoslashdi. Bir yillik birlamchi yakuniy nuqta FFR-TOKA guruhida 10,6% ni, AKSh guruhida esa 6,9% ni tashkil etdi (HR 1,5; 95% CI 1,1–2,2; $p=0,02$). Ushbu natijalar uch tomirli zararlanishlarda AKSh ning TOKA ga nisbatan ustunligini ko'rsatdi [29].

6. Lahzali to'liqsiz nisbat (iFR): FFR ga alternativa va ekvivalent usul

Lahzali to'liqsiz nisbat (iFR) - giperemiya holatini sun'iy ravishda yuzaga keltirishni talab etmaydigan tinch holatdagi fiziologik indeks hisoblanadi. iFR ko'rsatkichi yurak siklining diastolik to'liqsiz davrida o'lchanadi va FFR singari stenozning funksional ahamiyatini baholash imkonini beradi. $iFR \leq 0,89$ gemodinamik jihatdan ahamiyatli stenozni ko'rsatadi [30,31]. DEFINE-FLAIR tadqiqoti (2017, n=2492) 49 ta markazda iFR va FFR yo'riqnomali TOKA strategiyalarini taqqoslashdi. 1 yillik MACE iFR guruhida 6,8% ni, FFR guruhida esa 7,0% ni tashkil qildi ($p=0,78$ non-inferiority uchun) [30]. DEFINE-FLAIR tadqiqotining 5 yillik kuzatuv natijalari 2025-yilda JAMA Cardiology jurnalida nashr etildi: 5 yillik MACE iFR guruhida 15,5% ni, FFR guruhida esa 15,3% ni tashkil qildi (HR 1,02; 95% CI 0,84–1,23; $p=0,86$) [32]. iFR-SWEDEHEART tadqiqoti (2017) DEFINE-FLAIR bilan bir vaqtda nashr etildi. 1 yillik asosiy so'nggi nuqta iFR guruhida 6,7% ni, FFR guruhida esa 6,1% ni tashkil qildi ($p<0,001$ non-inferiority uchun) [31]. iFR-SWEDEHEART tadqiqotining 5 yillik kuzatuv natijalari 2022-yilda JACC jurnalida nashr etildi: 5 yillik MACE iFR guruhida 18,5% ni, FFR guruhida esa 19,0% ni tashkil qildi (HR 0,97; 95% CI 0,81–1,15; $p=0,71$) [33].

Table 2. Koronar fiziologik baholashga oid asosiy randomizatsiyalangan tadqiqotlar.

Jadval 2. FFR va iFR yo'riqnomali strategiyalarning klinik dalillari.

Tadqiqot	n	Taqqoslash	Asosiy natija
FAME [26]	1005	FFR-TOKA vs angiografiya-TOKA	1 yillik o'lim/MI/takroriy revaskulyarizatsiya: 13.2% vs 18.3%; $p = 0.02$.
FAME 2 [27,28]	888	FFR-TOKA vs konservativ terapiya	5 yillik shoshilinch revaskulyarizatsiya: 8.1% vs 19.5%; HR 0.39, 95% CI 0.26–0.57.
FAME 3 [29]	1500	FFR-TOKA vs AKSh	1 yillik birlamchi yakuniy nuqta: 10.6% vs 6.9%; HR 1.5, 95% CI 1.1–2.2.
DEFINE-FLAIR [30,32]	2492	iFR vs FFR	5 yillik MACE: 15.5% vs 15.3%; HR 1.02, 95% CI 0.84–1.23.
iFR-SWEDEHEART [31,33]	–	iFR vs FFR	5 yillik MACE: 18.5% vs 19.0%; HR 0.97, 95% CI 0.81–1.15.

7. Meta-analizlar: IVUS va fiziologik baholashning umumiy ta'siri

Buccheri va hamkasblarining 2017-yilda JACC Cardiovascular Interventions jurnalida nashr etilgan Bayesian network meta-tahlili 31 ta tadqiqot va 17 882 ta bemorni o'z ichiga oldi. Ushbu tahlil shuni ko'rsatdiki, IVUS yo'riqnomali TOKA angiografiya yo'riqnomasiga nisbatan MACE darajasini 27% ga kamaytiradi (OR 0,73; 95% CI 0,61–0,88) [34]. Darmoch va hamkasblarining 2020-yilda American Heart Association jurnalida nashr etilgan meta-tahlili 31 ta tadqiqot va 29 068 ta bemorni tahlil qildi. Ushbu tahlil shuni ko'rsatdiki, IVUS yo'riqnomali TOKA har qanday sababdan o'lim xavfini 40% ga (RR 0,60; 95% CI 0,48–0,74), maqsadli tomir revaskulyarizatsiyasini 31% ga (RR 0,69; 95% CI 0,59–0,81) va miokard infarktni 22% ga (RR 0,78; 95% CI 0,66–0,93) kamaytiradi [35]. 2024-yilda Lancet nashrida Raber tomonidan 20 137 nafar bemor ishtirokidagi 30 ta randomizatsiyalangan klinik sinovni o'z ichiga olgan keng qamrovli meta-tahlil chop etildi. Mazkur tahlilga ko'ra, IVUS yoki OKT yordamida o'tkazilgan TOKA, an'anaviy angiografiyaga qaraganda 2 yillik MACE darajasini 28% ga ishonchli ravishda kamaytirishi tasdiqlandi (HR 0,72; 95% CI 0,62–0,85). Qiyosiy tahlilda IVUS va OKT natijalari o'rtasida statistik ahamiyatga ega farq kuzatilmadi [36].

8. Zamonaviy klinik ko'rsatmalar va ularning amaliy tavsiyalari

Yevropa Kardiologlar Jamiyasi (ESC)ning 2024-yilda European Heart Journal nashrida chop etilgan surunkali koronar sindromlarni davolash bo'yicha yangilangan yo'riqnomasi zamonaviy intervension kardiologiya amaliyotida tomir ichi vizualizatsiyasi va fiziologik baholash usullarining o'rnini quyidagicha belgilaydi: murakkab koronar zararlanishlarda TOKA amaliyotini IVUS yoki OKT nazorati ostida amalga oshirish - I sinf, A darajali dalillar asosida tavsiya etiladi; oraliq (noaniq) stenozlarda FFR yoki iFR asosida qaror qabul qilish - I sinf, A darajali dalillar asosida tavsiya etiladi [3].

2021-yilda e'lon qilingan ACC/AHA/SCAI qo'shma yo'riqnomasi ham shunga o'xshash yondashuvni ilgari suradi. Lawton va hammualliflari tomonidan chop etilgan ushbu hujjatda ta'kidlanishicha, murakkab koronar zararlanishlarda tomir ichi vizualizatsiyasidan foydalanish (Class IIa tavsiya) va oraliq stenozlarda FFR yoki iFR bilan fiziologik baholash (Class I tavsiya) optimal davolash natijalariga erishishning garovi hisoblanadi [37]. 2018-yilda ESC/EACTS tomonidan chop etilgan Miokard revaskulyarizatsiyasi bo'yicha yo'riqnomada TOKA va AKSh amaliyotlari o'rtasida to'g'ri tanlovni amalga oshirishda tomir ichi vizualizatsiyasi va fiziologik baholash usullarining hal qiluvchi ahamiyati alohida ta'kidlangan [38]. Young va hammualliflarining 2020-yilda Journal of the American Heart Association nashrida chop etilgan tadqiqoti, murakkab koronar arteriya kasalligida ko'p tarmoqli Kardiologik konsilium yondashuvining ahamiyatini ta'kidlaydi [39].

Munozara

Ushbu sistematik adabiyotlar sharhida tahlil qilingan dalillar aniq ravishda shuni ko'rsatadiki, murakkab koronar zararlanishlarda tomir ichi vizualizatsiyasi va fiziologik baholash usullarini qo'llash klinik natijalarni sezilarli darajada yaxshilaydi. RENOVATE-COMPLEX-PCI tadqiqotining natijalari (HR 0,64; $p=0,008$) ayniqsa e'tiborli, chunki bu tadqiqot maxsus murakkab zararlanishlar populyatsiyasida o'tkazilgan. Raber va hammualliflarining 2024-yilgi Lancet meta-tahlili (HR 0,72; 95% CI 0,62–0,85) 30 ta RCT va 20 137 bemorni qamrab olgan holda, ushbu foyda umumiy va barqaror ekanligini tasdiqladi [36]. IVUS va OKT o'rtasidagi tanlov masalasida, OCTIVUS tadqiqoti (2023) ikkala usulning klinik samaradorlik jihatidan ekvivalent ekanligini isbotladi [25]. Bu natija amaliy kardiologiya uchun muhim, chunki vizualizatsiya usulini tanlashda zararlanishning xususiyatlariga qarab individual yondashuv qo'llash imkonini beradi - IVUS chuqurroq penetratsiyasi bilan kalsifikatsiya va plak yukini baholashda, OKT esa yuqori aniqligi bilan stent ekspansiyasi va disseksiyalarni baholashda afzaldir. Fiziologik baholash sohasida DEFINE-FLAIR va iFR-SWEDEHEART tadqiqotlarining 5 yillik kuzatuv natijalari FFR va iFR usullarining uzoq muddatda ham o'zaro ekvivalent natijalarni ta'minlashini tasdiqladi [32,33]. FAME 2 tadqiqotining 5 yillik natijalari esa FFR yo'riqnomali TOKAning shoshilinch revaskulyarizatsiya zaruriyatini sezilarli kamaytirishi (HR 0,39; $p<0,001$) bilan dalolat berdi [28]. Biroq, FAME 3 tadqiqoti (2022) uch tomirli kasallikda FFR-TOKA ning AKSh ga teng emasligi (non-inferiority isbotlanmadi) ni ko'rsatib, bu usullarning qo'llanilish chegaralarini belgiladi [29].

O'zbekiston sharoitida Fozilov va hammualliflarining tadqiqotlari koronar arteriya kasalligining mahalliy epidemiologik xususiyatlarini va profilaktika choralarining ahamiyatini ta'kidlaydi [6–8]. Mazkur ma'lumotlar O'zbekistonda murakkab koronar zararlanishlarni davolashda zamonaviy tomir ichi vizualizatsiyasi va fiziologik baholash usullarini joriy etish zarurligini yana bir bor tasdiqlaydi.

Xulosa

Ushbu sistematik adabiyotlar sharhi natijalariga asoslanib, quyidagi xulosalarni chiqarish mumkin:

Birinchidan, tomir ichi vizualizatsiyasi (IVUS yoki OKT) yo'riqnomasi bilan o'tkazilgan TOKA an'anaviy angiografiya yo'riqnomasiga nisbatan 2 yillik MACE darajasini 28% ga kamaytiradi (HR 0,72; 95% CI 0,62–0,85), bu esa ESC 2024 yo'riqnomasida I sinf, A darajali dalillar asosida tavsiya etilishining ilmiy asosi hisoblanadi.

Ikkinchidan, murakkab TOKA sharoitida tomir ichi vizualizatsiyasi yo'riqnomasi standart angiografiyaga nisbatan birlamchi yakuniy nuqtani 36% ga kamaytiradi (RENOVATE-COMPLEX-PCI: HR 0,64; $p=0,008$), bu esa ayniqsa yuqori xavfli bemor populyatsiyasida ushbu usullarning ahamiyatini ta'kidlaydi.

Uchinchidan, FFR va iFR fiziologik baholash usullari oraliq stenozlarda qaror qabul qilishni optimallashtiradi va 5 yillik kuzatuvda o'zaro ekvivalent natijalarni ta'minlaydi. IVUS va OKT usullari klinik natijalar bo'yicha ekvivalent bo'lib, vizualizatsiya usulini tanlashda zararlanishning xususiyatlaridan kelib chiqib individual yondashuv tavsiya etiladi.

O'zbekiston kardiologiya amaliyotida murakkab koronar zararlanishlarni davolash sifatini oshirish uchun tomir ichi vizualizatsiyasi va fiziologik baholash usullarini keng joriy etish bugungi kunning dolzarb vazifalaridan biri hisoblanadi.

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Authors' contribution

Conceptualization, Kh.F.; methodology, B.Y.; investigation, B.Y. and B.A.; writing—original draft preparation, B.Y. and B.A.; writing—review and editing, Kh.F. and B.Y.; supervision, Kh.F. All authors have read and agreed to the published version of the manuscript.

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Ethics approval

Not applicable. This systematic literature review did not involve any new intervention studies with human participants or animals.

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Data Availability Statement

The data supporting the results of this study are available from the authors upon reasonable request; the principal evidence discussed in this review is available in the cited literature.

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Conflict of interest

The authors declare no conflicts of interest.

Qisqartmalar

YuIK Yurak ishemik kasalligi
TOKA Teri orqali koronar aralashuv

Adabiyot

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