Intermittent Claudication – Functional Status Assessment in Patient Follow-up after Successful Percutaneous Revascularization

SAŽETAK: Porast angiontervencijskih zahvata posljedica je rastuće incidencije okluzivne bolesti perifernih arterija, ali i boljih tehničkih mogućnosti percutane revaskularizacije. Odluka o načinu liječenja temelji se na poroci kliničkoj procjeni bolesnika s intermittentnom kladikacijom Fontaine II klase i odabira terapijskih mogućnosti: endovaskularne ili kirurške revaskularizacije ili pak konzervativnog medicinskog liječenja uz intenzivan nadziranog trening hodanja. Posebno je važna racionalizacija u načinu praćenja bolesnika nakon provedenog revaskularizacijskog zahvata u eri različitih novih tehničkih mogućnosti medicinske prakse 21. stoljeća. Cilj ovoga retrospektivnog istraživanja odnosio se na skupinu bolesnika s bolešću perifernih arterija, funkcionalne klase Fontaine II u kojih smo nakon uspješne angiontervencije analizirali promjene vrijednosti ABI-ja (od engl. ankle brachial index) i dužine HP-a (hodna pruga) kroz vremenski slijedeći period: prije i neposredno nakon intervencije te u kontrolnom razdoblju. Uspješna endovaskularna revaskularizacija (PTA od engl. percutaneous transluminal angioplasty) u usporedbi sa standardnom farmakoterapijom i nenadziranim vježbama hodanja u bolesnika funkcionalne klase Fontaine II rezultirala je produljenjem HP-a i porastom ABI-ja, a koji nisu pokazali poboljšanje nakon inicijalnog 6-mjesečnog razdoblja primijenjene optimalne farmakoterapije i nekontroliranog treninga. Prisutnost komorbiditeta nisu utjecale na rezultate ispitivanih parametara. Vrijednost je ABI-ja konzistentalnog ekstremiteta tijekom praćenja porasla i korelira s porastom ABI-ja ekstremiteta podvrgnutih angiontervenciji. Odluka o treningu i praćenju bolesnika nakon uspješne endovaskularne revaskularizacije uključuje sadržaj i dubinu obiteljskog treninga hodanja. Podaci pokazuju da se u kriterijumu određivanja sezone treninga holistički osmatra i dalje se javlja nezgoda u određivanju sezone treninga u medicinskoj praksi.

SUMMARY: The rate of percutaneous endovascular treatment is increasing because of the high incidence of peripheral artery disease and improved endovascular techniques. Therapeutic decisions in patients with intermittent claudication are based on the patient’s functional impairment, specifically in the Fontaine II class. Endovascular or surgical revascularization versus optimal medical therapy with supervised exercise training is a very frequent dilemma in clinical practice. Patient surveillance and follow up after angiointerventions requires a rational approach in the era of new technical advancements in the 21st century. The aim of this retrospective study was to analyze changes in ankle brachial index (ABI) values and walking distance changes as functional status parameters after successful angiointerventions in the observational period: before intervention, after the procedure, and in follow-up. Increased ABI values and walking distance were associated with successful revascularization in the group of patients who did not respond to the initial standard medical treatment in the 6-month period. Comorbidities had no influences on data evaluated in the study. ABI values on the contralateral leg revealed a positive correlation with the incremental ABI values in the leg where revascularization was successfully performed. Significant increase in walking distance after percutaneous revascularization and significantly greater ABI values in follow-up confirmed the importance of both parameters that reflect successful angiographic findings after percutaneous transluminal angioplasty (PTA). Both parameters were consistent with successful revascularization and improved functional status in the follow-up period. Walking distance deserves to be reevaluated in the assessment of functional status in patients after successful percutaneous angiointerventional revascularization. It should not be neglected as a valuable parameter in estimating functional status after PTA.
Uvod
Prevalencija aterosklerotskih bolesti perifernih arterija je u po-rastu. Incidencija u populaciji starijih od 60 godina iznosi oko 20%1. U visokorizičnih bolesnika oboljelih od šećerne bolesti, arterijske hipertenzije, koronarne i cervebrovascularne bolesti incidencija je i do 30%. Periferna aterosklerotska bolest (PAB) prati i rastuću životnu dob pa je incidencija u starijim od 85 godina čak i 50%2. Mnogobrojni komorbiditeti, posebno u starijoj životnoj dobi, osim toga što modificiraju tipičnu kliničku sliku, pokakad utječu i na ishod liječenja povećavajući u ovoj populaciji vrlo visok kardiovaskularni rizik. S obzirom na vul-nerabilnost populacije zbog kardiovaskularnog rizika i čestih komorbiditeta važno je slijediti smjernice u dijagnostici i lije-čenju oboljelih od PAB-a, a personaliziranim se pristupom u izboru najpogodnijeg terapijskog rješenja nastoji postići maksimalan učinak uz najmanje nuspojava3. Dijagnostika i praćenje kliničkog toka oboljelih od PAB-a temelji se na pro-cjeni funkcionalnog statusa, anamneze, kliničkog statusa, pleťizmografije i ABI-ja (od engl. ankle brachial index, pedo-brahijalni indeks). Ultrazvučnim se pregledom u dijagnostici PAB-a objektivira anatomska i hemodinamska značajnost aterosklerotskoga procesa. Silkovine metode (MSCT ili MR an-giografija) nezostavni su dio dijagnostičkog algoritma kada je anatomski prikaz nužan radi planiranja i donošenja odlu-ke o najpogodnijim mogućnostima revaskularizacije. Specifi-čnost je ABI-ja oko 95% ako je njegova vrijednost manja od 0,9, a osjetljivost oko 79 – 95% u usporedbi s angiografijom kao metodom u otkrivanju okluzivne bolesti arterija4. Vri-jednosti ABI-ja i simptomi bolesti često ne koreliraju pa je stoga pokakad potrebno proveсти test opterećenja i odrediti ABI nakon završetka testa. Funkcionalna dijagnostika i ana-mneza često su zanemarene u procjeni težine kliničke slike, nerijetko zbog neracionalne primjene tehnički sofisticiranih dijagnostičkih metoda poput MR-i MSCT-a koje nedvojbeno imaju svoje mjesto u dijagnostici, ali i pojedina ograničenja4-6. Klasifikacija PAB-a po Fontaineu i Rutherfordu temelji se na procjeni statusa i funkcionalne sposobnosti bolesnika. Klasu I po Fontaineu čine bolesnici od PAB-a koji nemaju ograničava-jućih simptoma i bolova u hodu. Klasa II uključuje bolesnike koji imaju simptome intermitentne klaudivikacije. Podsckupina II A ima hodnu prugu (HP) dužu od 200 metara, a oboljeli iz podskupine II B pri prijenosu put kraćem od 200 metara osjećaju bol u ekstremitetu. Klasa III obuhvaća bolesnike koji imaju bolove u mirovanju, a klasu IV čine bolesnici s ulce-redacijama ili gangrenom. Klasa III i IV nedvojbeno pripadaju bolesnici u kojih je revaskularizacija apsolutno indiricirana zbog ugroženosti ekstremiteta. Bolesnici klasa I zahtijevaju praćenje uz modifikaciju stila života i korekciju čimbenika rizika, dok izbor optimalnog liječenja bolesnika sa stabilnom klaudivikacijom (Fontaine II) zahtijeva povratak kliničku procjenu uz primjenu medicinog liječenja te provođenja strukturiranih vježbi hodanja uz nadzor. Zbog izostanka sredstava iz zdravstvenog fonda za provođenje strukturiranih nadziranih vježbi hodanja, bolesnici treninge najčešće provode prozvoljno, što je često nedovoljno učinko-vito. Odluka o revaskularizaciji temelji se na kliničkoj procje-ni, tijeku bolesti, prisutnim komorbiditetima, dobi bolesnika i kliničkom tijeku bolesti, napose kad učinak fizikalnih i far-makoloških metoda liječenja nije učinkovit. Uliježenju stabil-nog tijeka intermitentne klaudivikacije uz korekciju čimbenika rizika, apstinencije od nikotina, regulacije tjelesne težine, 

Introduction
The prevalence of atherosclerotic peripheral artery disease is increasing. Incidence in the population over 60 years of age is about 20%. In high-risk patients suffering from diabetes, arte-rial hypertension, and coronary and cerebrovascular disease, the incidence can be up to 30%. Peripheral artery disease (PAD) also increases with age, so the incidence in those over 85 years of age is as high as 50%. Numerous comorbidities, especially at an advanced age, not only modify the typical clinical pres-entation but also occasionally influence the treatment out-comes, increasing the already very high cardiovascular risk in this population. Given the vulnerability of this population due to cardiovascular risk and very common comorbidities, it is important to follow the guidelines for the diagnosis and treatment of PAD, and a personalized approach should be used in choosing the optimal treatment with the goal of achieving the maximum effect with minimal side effects. Diagnosis and monitoring the clinical course in patients with PAD is based on assessing functional status, anamnesis, clinical status, plethysmography, and ankle brachial index (ABI). Ultra-sound examination in PAD diagnosis can objectivate the ana-tomic and hemodynamic significance of the atherosclerotic process. Imaging methods (MSCT or MR angiography) are an integral part of the diagnostic algorithm when anatomic im-aging is necessary for planning and decision-making regard-ing the optimal method of revascularization. The specificity of ABI is approximately 95% if its value is below 0.9, and the sensitivity is 79-95% in comparison with angiography as a method of discovering occlusive arterial disease. ABI values and disease symptoms are often uncorrelated, so it is some-times necessary to perform an exertion test and measure ABI after the test. Functional diagnostics and anamnesis are often neglected in assessing the severity of the clinical pres-entation, often due to over-implementation of technically so-phisticated diagnostic methods such as MR and MSCT, which undoubtedly have a role in diagnostics but are not without cer-tain limitations. Classification of PAB according to Fontaine and Rutherford is based on assessing the status and func-tional capacity of the patient. Fontaine stage I comprises patients with PAD who do not have limiting symptoms and pain while walking. Stage II comprises patients who have intermittent claudication symptoms. The II A subgroup has a walking dis-tance (WD) over 200 m, whereas patients in subgroup II B re-port pain in the extremities at walking distances below 200 m. Stage III comprises patients who report rest pain, and stage IV comprises patients with ulcerations or gangrene. Stage III and IV undoubtedly represent patients in whom revascularization is absolutely indicated due to danger to the extremities. Stage I requires monitoring and lifestyle modification with correc-tion of risk factors. Stage II requires implementation of minimal invasive treatment choice for patients with stable claudication (Fontaine II) requires a detailed clinical assessment with the application of medication treatment and structured walking exercises with supervision. Due to lack of financial support from healthcare funds for the implementation of structured supervised walk-ing exercises, patients usually conduct trainings arbitrar-ily, which is often not sufficiently effective. The decision on implementing revascularization is based on clinical assess-ment, disease progression, comorbidities, patient age, and the clinical course of the disease, especially when physicaltherapy and pharmacological treatments are not effective. In addition to risk factor correction, nicotine abstinence, and regulation of body weight, blood sugar levels, blood pressure, LDL cho-
Ispitnici i metode

Za istraživanje su iskorišteni podatci iz medicinske dokumentacije bolesnika liječenih u Klinici za bolesti srca i krvnih žila i u Kliničkom zavodu za dijagnostiku i intervenciju radiologiju KBC-a Zagreb. Od ukupno 135 bolesnika liječenih endovaskularnim metodama revaskularizacije tijekom 2018. godine, samo je 67 bolesnika ispunjavao zadane uvjete ovo-ga retrospektivnog ispitivanja, a to su: klinička slika intermitentne kardiopatije funkcionalne klase Fontaine II, izostanak terapijskog učinka konzervativnog liječenja tijekom početnog razdoblja od 6 mjeseci, učinjena perkutana endovaskularna revaskularizacija s dobrim angiografskim rezultatom, postojanje podataka o pruženju terapije u postproceduralnom razdoblju od 3 do 6 mjeseci u kontrolnom intervalu. Svi su bolesnici prije revaskularizacije u šestomjesečnom intervalu liječeni statinima, ACE inhibito-rima i acetylilcilatnom kiselinom (ASK), apstrinili su od nikotina i imali su motivacijski razgovor o potrebi svakodnevno-vog hodanja u trajanju od najmanje 30 minuta, tempom kojim je trebalo provocirati bol u ekstremitetu. Bolesnici su s prirodom bolesti, načinom liječenja i potrebom svakodnev-nog hodanja upoznati s pomoću pisanog teksta namijenjenog bolesnicima koji boluju od PAB-a. Oboljeli su reevaluirani 6 mjeseci nakon postavljanja dijagnoze. Zbog izostanka učin-ka ili čak pogoršanja funkcionalnoga statusa, HP-a ili i ABI-ja nakon šestomesečnog liječenja, provedena je MSCT angio-grafija na temelju koje je vaskularni tim procijenio koji su bolesnici pogodni za angionteravenciju i operaciju. Iako su svi bolesnici imali bilateralne aterošlerotsko promjene ar- terija donjih ekstremiteta, revaskularizacija je izvedena na simptomatskom ekstremitetu. U molog lesterol, and triglycerides, treating stable course intermittent claudication also requires daily walking and supervised phys-ical exercises. It is also necessary to include the application of antiaggregant medication as well as statins and ACE inhibi-tors in symptomatic phases of the disease. Physical activity consisting of walking training with supervision is certainly recommended, since its effectiveness is comparable to endo-vascular revascularization methods if the training is properly conducted. This is the reason for clinical dilemmas in deciding on treatment choice; optimal medical treatment and walking exercises, endovascular or surgical revascularization. The analysis was conducted in a group of patients who had under-gone percutaneous endovascular revascularization leading to a good angiographic effect, with the goal of studying the dy-namics of changes in ABI and WD parameters in the periods before and after angionteravencije and during follow-up.

Patients and Methods

We used data from medical documentation of patients treated at the Clinic for Cardiovascular Diseases and the Clinical Institute for Diagnostic and Interventional Radiology at the University Hospital Centre Zagreb. Out of a total of 135 pa-tients treated with endovascular revascularization methods in 2018, only 67 fulfilled the inclusion criteria for this retro-spective study, which were: a clinical picture with Fontaine stage II intermittent claudication, lack of response to con-servative treatment in the initial 6-month period, application of percutaneous endovascular revascularization with good angiographic results, availability of postprocedural follow-up data in 3- to 6-month intervals. Before revascularization, all patients underwent a 6-month interval of treatment that involved statins, ACE inhibitors, and aspirin, nicotine absti-nence, and a motivational conversation on the need for daily walks lasting at least 30 minutes at a pace that provoked pain in the extremities. The patients were also informed of the na-ture of their disease, the treatment method, and the need for daily walks via a leaflet designed for patients suffering from PAD. Patients were re-evaluated 6 months after the establish-ment of the diagnosis. Due to lack of treatment response or even deterioration of functional status, walking distance, and ABI after 6 months of treatment, MSCT angiography was used to allow the vascular team to assess suitability for angionteravental treatment. Although all patients had bilateral ather-oslerotic changes in arteries of the lower extremities, revas-cularization was performed only on the symptomatic leg. The ABI of all patients was measured within 48 h of successful completion of the procedure, followed by postprocedural ABI measurements at 3- to 6-month follow-up when the walking distance was noted based on the patient’s self-assessment.
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je broja bolesnika učinjena i bilateralna revaskularizacija pa
ti bolesnici nisu bili uključeni u ispitivanje, kao ni bolesnici
tointervenciji i 3 do 6 mjeseci nakon zahvata.

Svi su bolesnici u razdoblju od minimalno mjesec
da nakon izvedene intervencije liječeni dvojnom antagreg-
acijom u hodu izražena je u metrima, a analiziran je bio podatak prije

- traga je učinjena nakon odmora od 10 minuta u prostoriji sob
i mjerenja segmentalnih tlakova i određivanjem ABI-ja. Pre

- testa za standardnu procjenu protoka na temelju pletizmogra

Spearmanov test regresijske analize te χ² test za usporedbu

- test za signifikantnost parametara kontinuiranih varijabli,

SPSS 20.0 i Python verzija 3.7.1., Friedmanov test i Wilcoxonov

fistula. Karakteristike bolesnika prikazane su u

koja nisu zahtijevala transfuzijsko liječenje i 1 arteriovenska

retroperitonealno krvarenje, 3 hematoma puncture site

rvačenje, 5 (7.4%) bolesnika, to jedno

transfuzijsko liječenje i 1 arteriovenusna

fistula. Karakteristike bolesnika prikazane su u tablici 1.

Bilateral revascularization was performed in a small number of

patients, so these patients were not included in the study,

and neither were patients at Fontaine stage III or IV with life-

dangering critical ischemia and those in whom the angioint-

ervention was not technically successful. All patients were

treated with aspirin 100 mg and clopidogrel 75 mg daily for a

minimum of one month after intervention, followed by long-
term treatment with aspirin and high doses of statins as well

as adjusted doses of ACE inhibitors as the treatment standard

for PAD. Walking exercises were still part of the usual standard

recommendations. All patients underwent ABI measurement

24 to 48 h after the procedure and at 3- to 6-month follow-up.

Measurements were performed using the Vaso Guard Viasys
device for standard flow assessment based on plethysmogra

phy, segmental pressure measurement, and determining ABI.

The test was performed after the patient had a 10-minute rest

in a space at room temperature.

Anamnesis regarding walking distance was considered

relevant and was included in the analysis. Pain-free walking

distance was expressed in meters and data before the interven

tion and 3 to 6 months after the procedure were analysed.

SPSS 20.0 and Python version 3.7.1 were used for statisti

cal analysis. The Friedman and Wilcoxon tests were used

for determining significance for parameters with continuous

variables. The Spearman regression analysis test and the Chi-
squared test were used to compare categorical variables. The

level of significance was set at p<0.05.

Results

Data from 67 patients with symptomatic Fontaine stage II dis

ease and unilateral endovascular intervention with good an-
giographic results were included in the analysis. The disease

was bilateral in all the patients, and the intervention was per

formed only on the leg that was symptomatic and therefore a

limiting factor for patient quality of life. The results were ana

lysed chronologically: before intervention, immediately after

intervention, and at 3- to 6-month follow-up after percutaneous

transluminal angioplasty (PTA). Complications associated with

the procedure were present in 5 (7.4%) patients and included

one retroperitoneal haemorrhage, 3 puncture site hematomas

that did not require transfusion treatment, and 1 arteriovenous

fistula. Patient characteristics are shown in Table 1.

![Chart](https://via.placeholder.com/150)

TABLE 1. Patient clinical characteristics.

| Comorbidity                  | N (%) |
|-----------------------------|-------|
| Arterial hypertension       | 61 (91%) |
| Diabetes                    | 31 (46%) |
| Chronic renal disease       | 6 (9%) |
| Ischemic heart disease      | 12 (18%) |
| Cerebrovascular disease     | 6 (9%) |

![Chart](https://via.placeholder.com/150)

2020;15(9-10):250.
Vrijednosti ABI-ja izmjerene neposredno nakon intervencije, tj. unutar 48 sati, bile su signifikantno više u usporedbi s vrijednostima prije zahvata (0,65 ± 0,19 prije, 0,84 ± 0,18 poslije p <0,05). Značajna se razlika održala konstantnom i na kontrolnom pregledu 3 do 6 mjeseci poslije. Pozitivan učinak revaskularizacije u postproceduralnom razdoblju praćenja od 3 do 6 mjeseci uočen je na obama ekstremitetima: na ekstremitetu na kojem je učinjena revaskularizacija, ali i na kontralateralnoj strani (tablice 2, 3 i 4). Promjena vrijednosti ABI-ja ekstremiteta podvrgnutih revaskularizaciji u postintervencijskom razdoblju praćenja pozitivno korelira i s vrijednostima ABI-ja suprotne noge u kontrolnom intervalu (Spearmanov koeficijent korelacije = 0,45; p <0,01).

**Diskusija**

Angiointervencijsko liječenje s angiografski uspješnim rezultatom dovelo je do signifikantnog porasta vrijednosti ABI-ja i HP-a u bolesnika u kojih u razdoblju od šest mjeseci prije intervencije konzervativno liječenje nije imalo učinka. ABI changes immediately after successful PTA with stable, unchanged values during follow-up and statistically significant increase in walking distance during follow-up represent evidence for the stability of successful angiointerventional procedures in the general patient population.

Angiointerventional treatment with angiographically successful results lead to a significant increase in ABI and walking distance values in patients who showed lack of response to conservative treatment in a 6-month period before the intervention. ABI changes immediately after successful PTA with stable, unchanged values during follow-up and statistically significant increase in walking distance during follow-up represent evidence for the stability of successful angiointerventional procedures in the general patient population.

The results of previous studies as well as those from the present study confirm that walking training and pharmacotherapy can be expected to lead to clinical and functional improvement of PAD given that this study has found an increase in ABI values on the leg that did not undergo revascularization.

### Table 2. Ankle brachial index values and walking distance before endovascular interventions and in follow-up.

| ABI value/number of pts | Before PTA | Follow up | P value |
|-------------------------|------------|-----------|---------|
| Right (N=27)            | 0.66±0.21  | 0.84±0.15 | 0.012   |
| Left (N=40)             | 0.65±0.13  | 0.91±0.18 | 0.002   |

| Walking distance (meters) | Before PTA | Follow up | P value |
|---------------------------|------------|-----------|---------|
| Right side intervention   | 191.8±267.7| 846.1±269.6| 0.004   |
| Left side intervention    | 194.9±285.5| 867.8±311.1| 0.003   |

ABI = ankle brachial index; PTA = percutaneous transluminal angioplasty

### Table 3. Ankle brachial index values before and after interventions and in follow-up on the contralateral leg.

| ABI left | Before PTA | After PTA | Follow up | P value |
|----------|------------|-----------|-----------|---------|
| Right leg PTA (N=27) | 0.86±0.21 | 0.81±0.26 | 0.89±0.16 | 0.10    |

| ABI right | Before PTA | After PTA | Follow up | P value |
|-----------|------------|-----------|-----------|---------|
| Left leg PTA (N=40) | 0.81±0.20 | 0.87±0.15 | 0.91±0.15 | 0.05    |

ABI = ankle brachial index; PTA = percutaneous transluminal angioplasty
rast vrijednosti ABI-ja u kontralateralnom ekstremitetu statistički je značajan, iako se razlika u porastu vrijednosti ABI-ja ne može smatrati funkcionalno relevantnom jer je porast ABI-ja lijevo iznosio prosječno 0,1. Sobieszczyk i sur. 16 smatraju da je porast vrijednosti ABI-ja od 0,15 klinički značajna promjena, kao odraz boljeg arterijskog protoka. O promjenama ABI-ja u slučaju konzervativnog, neintervencijskog liječenja koje bi činile diskriminirajuću razliku poboljšanja nema dovoljno podataka. Porast vrijednosti ABI-ja rezultat je porasta tlaka zbog restitucije protoka magistralnom arterijom. Promjene ABI-ja uz poboljšanje ukupne perfuzije formiranjem novonastalih kolateralni, što je uglavnom rezultat koji se očekuje primjenom konzervativnih mjera liječenja, nisu dokazane. 15,16 Pitanje izostanka učinka konzervativnih mjera liječenja prije učinjenih PTA vezano je za selekciju bolesnika kakvu često susrećemo u kliničkoj praksi, iako su bolesnici liječeni u skladu sa smjernicama za liječenje PAB-a 4. Increase in ABI values on the contralateral leg was statistically significant although the difference in ABI value increase cannot be considered functionally relevant, because the ABI increase in the left leg was 0.1 on average. Sobieszczyk et al. 16 believed that an ABI increase of 0.15 represents a clinically significant change that reflects improved arterial flow. There is insufficient data on ABI changes that would represent a discriminating difference in improvement for conservative, non-interventional treatment. Increase in ABI values is the result of increased blood pressure due to restitution of flow in the main artery. There is insufficient evidence for ABI changes with improvement of total perfusion through the formation of new collaterals, which is usually the expected result of applying conservative treatment measures. 15,16 The issue of lack of effect from conservative treatment measures prior to PTA is associated with patient selection common in clinical practice, despite the patients having been treated according to guidelines for PAD 4. Increase in ABI values in the leg where the endovascular revascularization was not performed is likely the consequence of improved patient compliance and the compounded effect of pharmacotherapy application, application of dual antiplatelet therapy, but also of higher-quality physical training that is being more rigorously applied due to increased walking distance after PTA on the symptomatic leg. These results are in line with ESC guidelines for PAD treatment.

| Table 4. Ankle brachial index values and claudication distance before percutaneous transluminal angioplasty and in follow-up. |
|-------------|
| Age years   | ABI before | ABI follow up | P value | CD before | CD in follow up | P value |
| <65 N=26    | 0.77±0.17  | 0.89±0.16    | 0.07    | 161±239   | 824±347        | 0.001   |
| > 65 N=41   | 0.58±0.15  | 0.87±0.18    | 0.006   | 217±299   | 883±247        | 0.001   |
| Diabetes    | YES (46%)  | 0.65±0.22    | 0.85±0.15| 0.049    | 267±343        | 0.02    |
|             | NO (54%)   | 0.66±0.15    | 0.91±0.18| 0.03     | 143±207        | 942±237 | 0.001   |
| Hypertension| YES (91%)  | 0.67±0.18    | 0.87±0.18| 0.01     | 183±255        | 869±285 | 0.001   |
|             | NO (9%)    | 0.60±0.22    | 0.93±0.05| 0.09     | 300±468        | 700±424 | 0.32    |
| Target lesion| CIA, EIA, SFA, PA (94%) | 0.65±0.19 | 0.88±0.17| 0.001    | 203±284        | 854±293 | 0.001   |
| Below the knee| (6%)      | 0.70±0.15    | 0.84±0.15| 0.223    | 85±85*         | 1000*   | *       |

ABI = ankle brachial index; PTA = percutaneous transluminal angioplasty; CD = claudication distance; CIA = common iliac artery; EIA = external iliac artery; SFA = superficial femoral artery; PA = popliteal artery
Ispitavana je populacija bila izložena mulitprim korom bilitama, i to najčešće arterijskoj hipertenziji. Prisutnost različitih koromobditeta nije utjecala na rezultate intervencije i ispitivane parametre, vrijednost HP-a i ABI-ja. Arterijska hipertenzija bila je odsutna u samo 9% ispitanika, što čvrsto povezuje okluzivnu bolest arterija i povišeni arterijski tlak. Ipak u ovoj skupini angiointervencija dovela do porasta ABI-ja i znatnog produljenja HP-a, sukladno rezultatima drugih autora.

Dobar je učinak angiointervencijalne revaskularizacije, s obzirom na promjenu duljine HP-a i porast vrijednosti ABI-ja, ostvaren samo u ispitanicima starijim od 65 godina. Svaka različitost može biti posljedica manjeg uzorka bolesnika mlađih od 65 godina (37%), ali i inicijalno boljih vrijednosti ABI-ja prije intervencije, što nije dovelo do značajne razlike u zabilježenim vrijednostima. U istoj je skupini produljenje HP-a bilo statistički značajno (p<0,001). Dužina HP-a je parametar koji je iako nije verificiran metoda mjerenja u kontroliranim uvjetima, nego je dobiven iskazom bolesnika o njegovoj dužini, u svim ispitivanim kategorijama pokazao znatan porast vrijednosti u promjenu funkcionalnog statusa u bolesnika nakon PTA-a. Porast dužine HP-a postignut je u svim dobim skupinama i neovisno o prisutnosti koromobditeta, s visokom razinom i statistički značajnim prijenosima. Porast ABI-ja nakon angiointervencije u ukupnoj populaciji bio je statistički značajan (p<0,05), a ipak u pojedinim ispitivanim kategorijama i karakteristikama skupine nije pratio statistički značajan porast HP-a. Nepodudarnost je, iako je bila riječ o proporcionalno malim brojevima, učena s obzirom na varijable: životna dob, u bolesnika koji nisu imali arterijsku hipertenziju i u grupi u kojoj je učinjena PTA po smještenih arterija. Variabilnosti vrijednosti ABI-ja zamijećene su u mnogim ispitivanjima. Rezultati Registra PORTRAIT PAK pokazuju da upravo maksimalna dužina HP-a i prijenos udaljenost bez klaudivicije reproducirano označuje i procjenjuje funkcionalni status bolesnika u svakodnevnom životu i kliničkoj praksi, dok su vrijednosti ABI-ja utpise u funkcionalnoj procjeni, ali ne i u procesu probira i rane detekcije PAB-a, kada je značenje ABI-ja neupitno.

Rezultati Amighi i sur. pokazali su da je kontroliranim programima tjelesne vježbe te metodama konzervativnog liječenja moguće postići smanjenje simptoma uz poboljšanje kvaliteti života te porast maksimalne duljine hodne pruge s početnih 100 metara na duljinu od 650 metara tijekom razdoblja unutar godine dana, ali bez znatnih promjena vrijednosti ABI indeksa. Osjetljivost ABI-ja u praćenju pruženosti nakon revaskularizacije može se postići i primjenom ABI stres testa, što bi, zasigurno, bio vrijedan i reproducirnili podatok

Zaključci
Uspješna endovaskularna revaskularizacija (PTA) u usporedbi sa standardnom farmakoterapijom i nenadziranim vježbama može donijeti u bolesnika funkcionalne klase Fontaine II rezultata s promuljenu vrijednostih HP-a i porastom ABI-ja. Prisutnost koromobditeta nisu utjecale na rezultate ispitivanih parametara. Promjena ABI indeksa na ekstremitetu na kojemu je provedena intervencija u razdoblju praćenja bila je značajna i očekivana. Usješnost i „stabilnost” uspješne re-

The population in the present study was exposed to multiple comorbidities, most commonly arterial hypertension. The presence of different comorbidities did not affect the results of the intervention or the study parameters, namely walking distance and ABI. Normal blood pressure was present in only 9% of participants, which points to a strong association between occlusive arterial disease and elevated arterial pressure.

In the subgroup of participants with diabetes, high ABI values prior to intervention were expected because the arteries affected by medial sclerosis in diabetes become incompressible, leading to high ABI values. However, angiointervention led to ABI increase even in this subgroup, as well as to increased walking distance, which is in agreement with results reported by other authors.

Good effects from angiointerventional revascularization on walking distance and ABI increase were achieved only in participants above 65 years of age. The explanation for this difference could be the smaller sample of patients younger than 65 years of age (37%), but also their initially better ABI values before intervention, which led to being no significant difference in postinterventional values. Increase in walking distance in the same group was statistically significant (p<0.001). Despite the fact that the walking distance is a parameter that was not verified with measurements in controlled conditions but was obtained through self-reporting, there was a statistically significant increase in walking distance with change in functional status after PTA in all patient categories. Increase in walking distance was achieved in all age groups and regardless of the presence of comorbidities, with a high level of both clinical and statistical significance. Increase in ABI after angiointervention was statistically significant in the total population (p<0.05), but did not parallel the statistically significant increase in walking distance for certain study categories and group characteristics. There was a lack of correspondence, albeit proportionally small, for the following variables: age, patients who did not have arterial hypertension, and in the group in which PTA was performed on the lower leg. Variable ABI values were observed in many studies. Results from the PORTRAIT PAK registry indicated that maximum walking distance and claudication-free walking distance represent a reproducible marker of functional status in patients both in their everyday life and in clinical practice, whereas ABI values were of questionable value in functional assessment, but not in the screening and early detection for PAD, where the importance of ABI is beyond question.

Results reported by Amighi et al. showed that controlled exercise programs and conservative treatment methods can achieve a reduction in symptoms with an improvement in quality of life, as well as increased walking distance from an initial 100 m to 650 m within a year, but with no significant change in ABI values. The sensitivity of ABI for measuring flow after revascularization can also be achieved through the application of an ABI stress test, which would certainly represent valuable and reproducible data.

Conclusions
Successful endovascular revascularization (PTA) in comparison with standard pharmacotherapy and unsupervised walking exercises in patients with Fontaine stage II resulted in increased walking distance and ABI. Presence of comor-
vaskularizacije procijenjene vrijednostima ABI-ja i dužinom HP-a bila je prisutna i tijekom praćenja. Vrijednost ABI-ja kontrateralnog ekstremita i razdjelju praćenja je porasla i korelira s porastom ABI-ja ekstremita podvrgnuti angiointervenciji. Na temelju prikazanih rezultata analize može se reprozicionirati značenje procjene dužine HP-a kao često za nemarenog podatka koji bi trebao biti neizostavan parametar u praćenju uspjeha revaskularizacije i funkcionalnoga statusa bolesnika s PAB-om.

bilities did not affect the results of the study parameters. Changes in ABI during the follow-up period in the leg where the revascularization was performed were significant and expected. The successfulness and “stability” of successful revascularization assessed through ABI values and walking distance was also observed during follow-up. ABI values in the contralateral leg were increased in the follow-up period and correlated with ABI increase in the leg on which angiointervention was performed. Based on these results, walking distance assessment represents a commonly neglected factor that should be reevaluated and considered as an important parameter in monitoring revascularization successfulness and functional status of patients with PAD.

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