

POSTER PRESENTATION

SECOND EVSS
Regional Conference

Leading Vascular Science

May 3-5, 2024
Intercontinental Hotel, Dubai

Using electrical stimulation to treat chronic wounds in patients with diabetic foot syndrome within a multidisciplinary approach

E.V. Tsvetkova, Yu.K. Panteleva, D.V. Chernova, A.G. Vanyurkin, M.A. Chernyavsky

INTRODUCTION

We estimated the effectiveness of the multidisciplinary specialists team to the treatment of patients with the neuroischemic form of diabetic foot syndrome in Almazov National Medical Research Centre

AIM

The purpose of the study is to estimate the effectiveness of the work of a multidisciplinary team of specialists from the Almazov National Medical Research Centre for the treatment of patients with neuroischemic form of diabetic foot syndrome using multimodal wearable devices for real-time physiological monitoring and active intervention to promote healing of chronic wounds

Table 1 Characteristic of patients included in study

Gender	Female - 52.94% (n = 27)	Male - 47.05% (n = 24)
Diabet	diabetes type 1 1,96 % (n = 1)	diabetes melitus 98,03 % (n = 50)
Smoking	37,24 % (n = 19)	
BMI	28,45 [20,1-40,6, M = 28,6]	
Age, years	72 [52-88, M = 72]	
Duration of disease, years	17,56 [1-42, M = 16]	
GFR (MDRD)	60,86 [5-113, M = 64]	
HbA1C	7,98 [4,7-12,2, M = 8]	
Oral hypoglycemic therapy	29,41 % (n = 15)	
Insulin therapy	21,56 % (n = 11)	
Glucose blood level	8,33 [3,3-16,3, M = 7,9]	
Damage to the coronary arteries	60,78 % (n = 31)	
Damage to the coronary arteries	68,75 % (n = 33)	
Myocardial infarction	43,75 % (n = 21)	
Stroke	23,52 % (n = 12)	
Amputations	66,6 % (n = 34)	

Fig. 1 Stages of healing of a chronic wound in a patient with diabetic foot syndrome



METHODS

We analyzed a multidisciplinary approach in the treatment of patients with diabetic foot syndrome retrospectively who were hospitalized to Almazov National Medical Research Centre during the period from January 2018 to July 2020.

The study included patients over 18 years of age with diabetes mellitus who revascularization in the clinic of vascular surgery during one hospitalization period.

We excluded from the study patients with secondary diabetes mellitus and immunosuppressive therapy.

51 patients with neuroischemic form of diabetic foot syndrome were specifically selected for analysis. So, the period of observation was from 2 years 8 months (32 months) to 4 years 8 months (56 months), the median time was 44 months (3.67 years). All inclusive patients had a diabetic ulcer on the foot, including those with chronic non-healing wounds. The endpoints of this study were the healing or non-healing of foot diabetic ulcers, major amputation or death.

Table or graph title

Survival function (Kaplan-Meier)

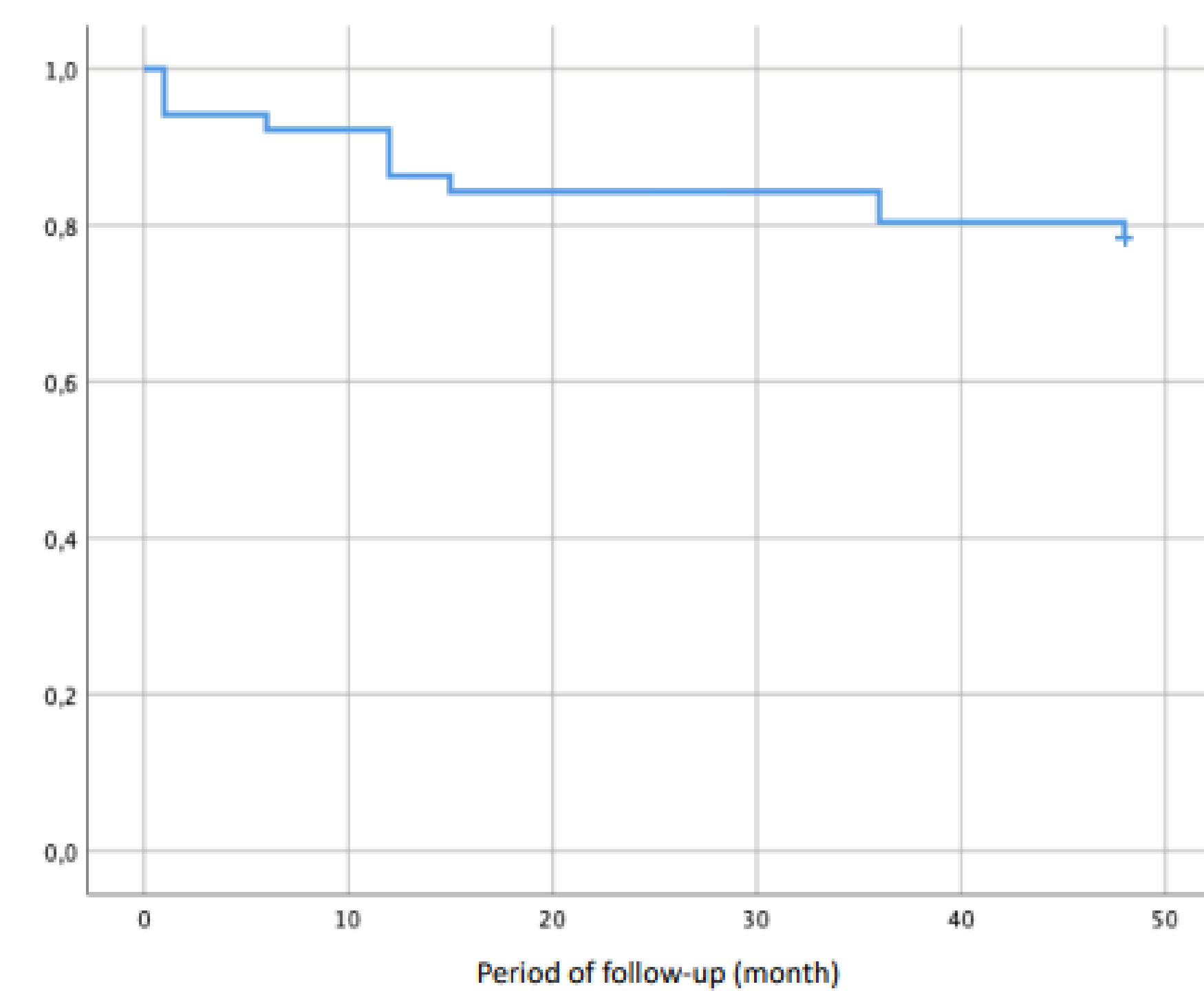


Fig. 2.3 Prototype of a smart bandage for the treatment of chronic wounds



Smart Bandage With Wireless Strain and Temperature Sensors and Batteryless NFC Tag Pablo Escobedo et al. IEEE Internet of things Journal, vol. 8, N. 6, MARCH 15, 2021
Jiang Y. et al Wireless, closed-loop, smart bandage intergrated sensors and stimulators for advanced wound careand accelerated healing. Nat Biotechnol, 1,652-662, 2023

RESULTS

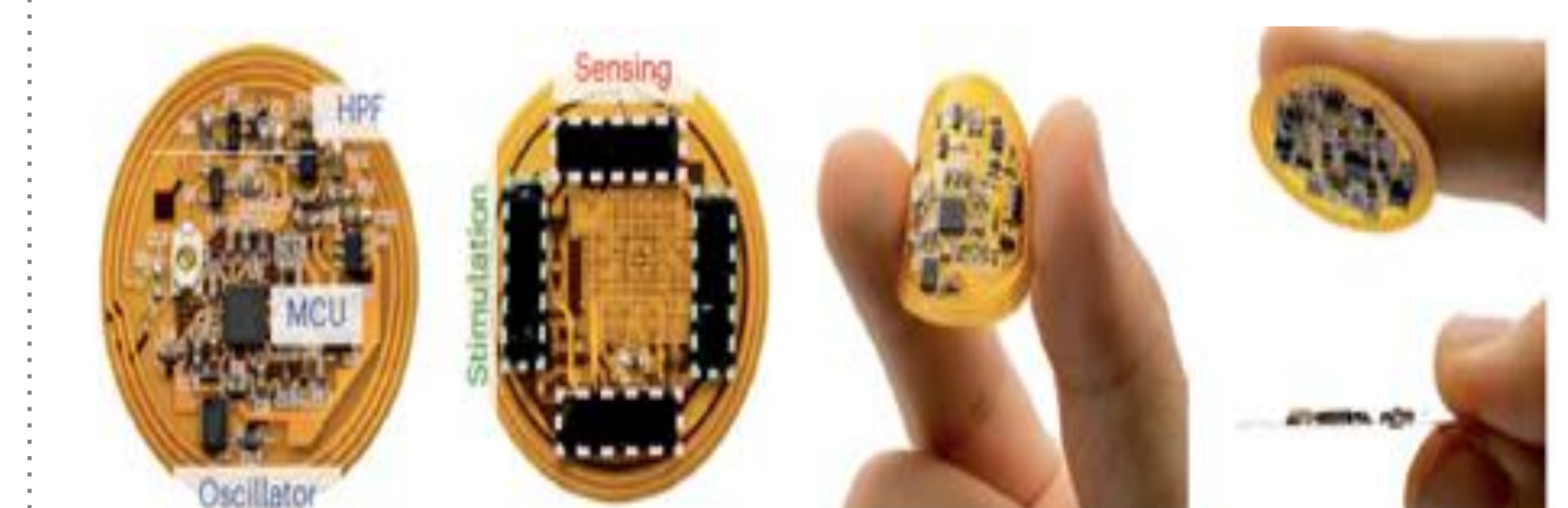
Successful healing of ulcers or postoperative wounds was in majority of patients (n= 45, 88,3 %). In 56.86% of patients, ulcers was healed and the injury occurred 3 months after surgery. 70.59% (36 patients) underwent orthopedic organ-preserving reconstructions on the foot. For 9 patients (17.64 %) it was required to perform repeated orthopedic intervention on the foot during the current hospitalization. The causes of complications were: stent thrombosis (n=3), intimal dissections (n = 2) and distal embolism (n = 1). The reasons for repeated orthopedic surgery were marginal necrosis in the postoperative wounds.

Optimal revascularization wasn't achieved in 10 (19.6 %) patients. In 4 (7.84 %) cases chronic wound was healed. Indirect revascularization with no effect was performed in 4 cases (7.84 %). 6 major amputations (11.7 %) were performed during the observation period, 1 major amputation during the current hospitalization and 5 in the long-term period. The Kaplan-Mayer three-year survival rate was 80 %.

In order to improve postoperative healing of chronic wounds of the diabetic foot, now we implement that could enable real-time physiological monitoring and active intervention of chronic wounds – smart bandage.

The functions of the smart bandage include detection of the physiological state of the wound environment: determination of pH, temperature, oxygenation, enzymatic fluctuations of the environment, followed by a monitoring function with the ability to remotely transfer data to personal devices: PC, smartphone.

Fig. 4 Prototype of a smart bandage for the treatment of chronic wounds



CONCLUSIONS

Of course, a multidisciplinary approach in the treatment of patients with diabetic foot syndrome, helps us to achieve there was an improvement in the preservation of limbs and a reduction in the period of reconstructions, reducing hospital stays and improving the lives of patients. The use of modern electrical stimulation technology in the form of smart bandages with simultaneous data transfer can significantly shorten the postoperative rehabilitation period, reduce the incidence of wound infections due to the antimicrobial effect of electrical stimulation, reduce the number of complications (amputations of limbs) and significantly reduce the economic costs of healthcare. The use of this approach will open up new opportunities in the treatment of diabetic foot syndrome.

BIBLIOGRAPHY

- de Mast Q, Beutler J. The prevalence of atherosclerotic renal artery stenosis in risk groups: a systematic literature review. J Hypertens. 2009; Jul;27(7):1333–40.
- Jones WS, Patel MR, et al. Temporal trends and geographic variation of lowerextremity amputation in patients with peripheral artery disease: results from U.S. Medicare 2000–2008. J Am Coll Cardiol. 2012;60:2230–6.
- Monteiro-Soares M1, Martins-Mendes D, et al. Classification systems for lower extremity amputation prediction in subjects with active diabetic foot ulcer: a systematic review and metaanalysis. Diabetes Metab Res Rev. 2014 Feb 12. DOI: 10.1002/dmrr.2535.
- Markakis K, Bowling F, Boulton A. The diabetic foot in 2015: an overview. Diabetes Metab Res Rev. 2016; 32(Suppl. 1): 169–178.