Foot Care and Diabetic Neuropathy

Anthony Decuir, Jr., DPM

WELL-AHEAD

Project ECHO®

Prevention!!!

WELL-AHEAD

Project ECHO

Impact of Diabetic Neuropathy

- 60-70% of foot ulcers are preceded by Neuropathy
- 85% of diabetes related lower limb amputations are preceded by a foot ulceration
- Most Common Proximate, Nontraumatic Cause of Amputations
- Largest number of diabetes related hospital bed-days

Gordois et al. Diabetes Care. 2003;26:1790-1795.
Reiber G, et al. Diabetes in America. 1995; 2nd ed:409-428.
Reiber GE, Vilekyte L, Bokyo EJ et al. Diabetes Care.1999;22.
Pecoraro RE, Reiber GE, Burgess EM. Diabetes Care. 1990;13.
Frykberg R, et al. Journ of Foot and Ankle Surgery 2006;45(5):S2-S8

THE REAL COST OF DIABETES

DIABETIC FOOT COMPLICATIONS ARE COMMON AND COSTLY

DIABETIC FOOT HEALTH

Up to **25%** of those with **DIABETES** will develop a **FOOT ULCER**

Estimated annual U.S. burden of diabetic foot ulcers is at least **$15 BILLION**

COST OF DIABETES IN THE US

$176 BILLION direct medical costs

$69 BILLION indirect medical costs (disability, reduced productivity, premature death)

INVESTMENT IN CARE

$1 invested in care by a podiatrist results in **$27** to **$51** of savings for the health-care system, among patients with commercial insurance.

$1 invested in care by a podiatrist results in **$9** to **$13** of savings, among Medicare eligible patients.

OUTSMART DIABETES

Podiatric medical care can reduce amputation rates up to **80%**

The inclusion of care provided by podiatrists for those with diabetes alone will save the health-care system **$3.5 BILLION** per year.

APMA

YOU CAN OUTSMART DIABETES WITH TODAY'S PODIATRIST

FOR MORE INFORMATION VISIT WWW.APMA.ORG

Expensive and Deadly: The Real Cost of Diabetes

Get RSS feed of the latest Press Releases!

Media Contact

Peggy S. Tresky, MA

Director, Communications

301-581-9200

pstresky@apma.org

November 1, 2014
Brielle Day
bcday@apma.org
301-581-9220

Diabetic foot complications cost more than the five most costly forms of cancer

WASHINGTON—For Americans, the cost of diabetes has never been greater. Not only does the disease cause detriment to the well-being of citizens, it also puts a tremendous financial burden on the country. More than 29.1 million people in the US suffer from diabetes, and diabetes costs us upwards of $245 billion per year.

A major cost associated with diabetic medical care is lower-limb amputation. Diabetes can cause patients to lose sensation in their extremities, so an individual may not immediately notice injuries to his or her feet. This condition can cause diabetic ulcers—wounds on the feet that are slow to heal and prone to infection—which often require amputation. In 2013, about 73,000 Americans with diabetes needed amputations. The average cost for each amputation is over $70,000.

"For those who have diabetes or are at risk for the disease, regular checkups by a podiatrist are one of the easiest ways to prevent most foot complications," said American Podiatric Medical Association (APMA) President Frank Spinosa, DPM. "Including a podiatrist in your care can reduce amputation rates by as much as 85 percent."

A study by APMA found that among patients with commercial insurance, each $1 invested in care by a podiatrist results in $27 to $51 of savings for the health-care system. Among Medicare-eligible patients, each $1 invested in care by a podiatrist results in $9 to $13 of savings.

"With proactive foot care, diabetes patients can reduce the risk of infection and amputation, improve function and quality of life and reduce health care costs," Dr. Spinosa added.

To learn more, and to find a podiatrist in your area, visit www.apma.org.

View an infographic on the cost of diabetes nationwide.

The American Podiatric Medical Association (APMA) is the nation's leading professional organization for today's podiatrists. Doctors of Podiatric Medicine (DPMs) are qualified by their education, training, and experience to diagnose and treat conditions affecting the foot, ankle, and structures of the leg. APMA has 53 state component locations across the United States and its territories, with a membership of more than 12,000 podiatrists. All practicing APMA members are licensed by the state in which they practice podiatric medicine. For more information, visit www.apma.org.

Enter Keyword Search

SciDoc Publishers
Infer, Interpret & Inspire Science

Menu

International Journal of Diabetology & Vascular Disease Research (IJDVR) » IJDVR-2328-353X-04-501

The Risk of Subsequent Amputation Following An Initial Lower Extremity Amputation: A Systematic Review

Wong CK[1*], Stern JR[2], Rick F D'Andrea Jr[3], Loven SL[3], Panjaki S[4], See AS[3], Spindler SJ[3], Yerovinkina M[3], Nowygrod R[2]

1 Department of Rehabilitation and Regenerative Medicine, Columbia University Medical Center, Neurological Institute, New York, NY, USA.
2 Department of Surgery, New York Presbyterian Hospital, Herbert Irving Pavilion, New York, NY, USA.
3 Program in Physical Therapy, Columbia University, Neurological Institute, NY, USA.

***Corresponding Author**

Christopher Kevin Wong, PT, PhD,
Department of Rehabilitation and Regenerative Medicine,
Columbia University Medical Center, 710 West 168th Street, Neurological Institute 8-822, New York, NY, USA.
Tel: 01-212-305-3781/ 01-914-738-9276
Fax: 01-212-305-4569
E-mail: ckw7@cumc.columbia.edu

Received: July 27, 2016; **Accepted:** October 26, 2016; **Published:** October 27, 2016

Citation: Wong CK, Stern JR, Rick F D'Andrea Jr, Loven SL, Panjaki S, et al., (2016) The Risk of Subsequent Amputation Following An Initial Lower Extremity Amputation: A Systematic Review. Int J Diabetol Vasc Dis Res,. 4(5), 171-177. **doi:** dx.doi.org/10.19070/2328-353X-1600036

PubMed.gov
Advanced

Comparative Study

Fate of the contralateral limb after lower extremity amputation

Julia D Glaser et al. J Vasc Surg. 2013 Dec.

Free PMC article

Show details | Full text links | Cite | ...

Abstract

Objective: Lower extremity amputation is often performed in patients where both lower extremities are at risk due to peripheral arterial disease or diabetes, yet the proportion of patients who progress to amputation of their contralateral limb is not well defined. We sought to determine the rate of subsequent amputation on both the ipsilateral and contralateral lower extremities following initial amputation.

Risk of reamputation in diabetic patients stratified by limb and level of amputation: a 10-year observation.

Diabetes Care. 2006; 29(3):566-70 (ISSN: 0149-5992)

Izumi Y; Satterfield K; Lee S; Harkless LB

Journal of Foot and Ankle Research

Home About Articles Submission Guidelines Thematic Series Submit manuscript

Commentary | Open Access | Published: 24 March 2020

Five year mortality and direct costs of care for people with diabetic foot complications are comparable to cancer

David G. Armstrong, Mark A. Swerdlow, Alexandria A. Armstrong, Michael S. Conte, William V. Padula & Sicco A. Bus

Journal of Foot and Ankle Research **13**, Article number: 16 (2020) | Cite this article

22k Accesses | **236** Citations | **441** Altmetric | Metrics

Abstract

Background

In 2007, we reported a summary of data comparing diabetic foot complications to cancer. The purpose of this brief report was to refresh this with the best available data as they currently exist. Since that time, more reports have emerged both on cancer mortality and mortality associated with diabetic foot ulcer (DFU), Charcot arthropathy, and diabetes-associated lower extremity amputation.

Preventing Diabetes-Related Amputations

Print

Lower-limb amputations (LLA), which is surgery to remove a toe, foot, or leg, are increasing in the US, and 80% are a result of complications from diabetes. From 2009 to 2019, the number of diabetes-related hospitalizations due to amputation doubled.

But the good news is that most diabetes-related amputations can be prevented with lifestyle changes, blood sugar management, regular foot checks, and prompt wound care when needed.

A small cut on the foot can become a serious infection that could require amputation if left untreated.

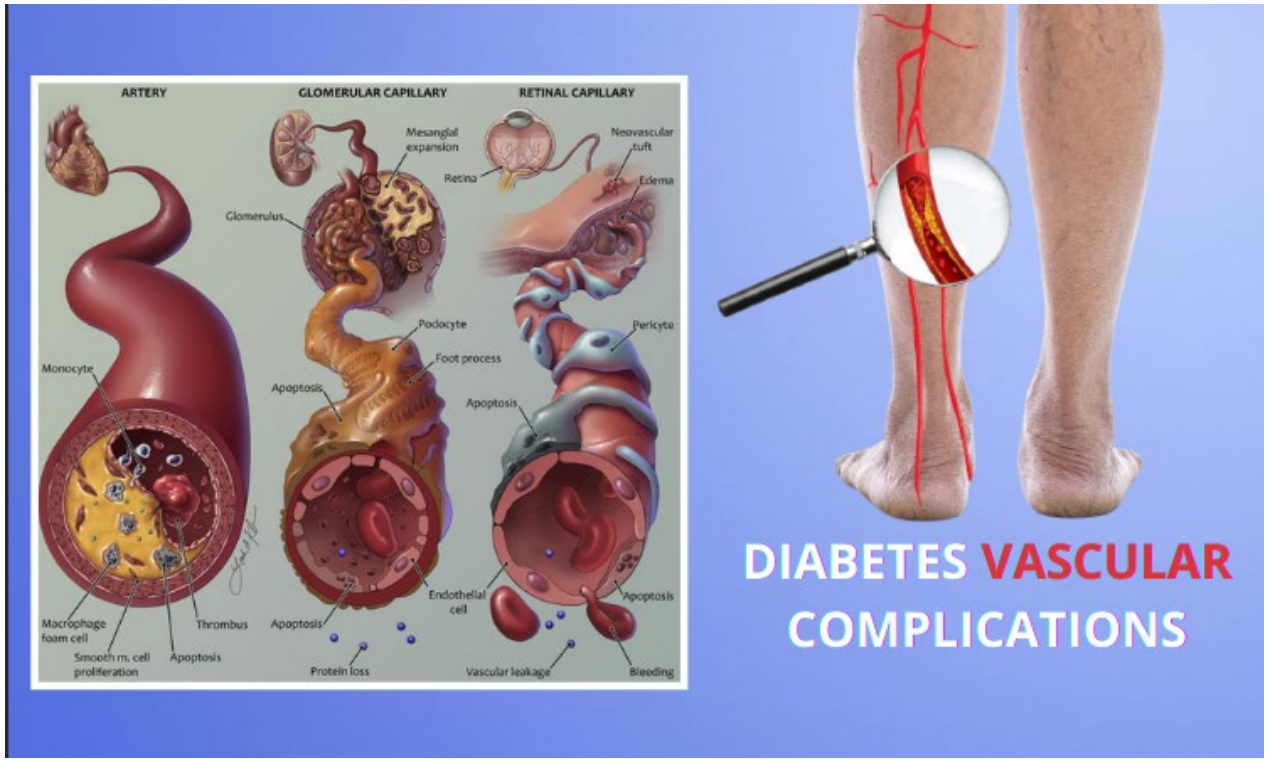
How Diabetes Can Lead to an LLA

High blood sugar over time can cause diabetes complications that raise the chance of an LLA:

- **Peripheral arterial disease (PAD)** can narrow the blood vessels that carry blood to your legs and feet. Poor blood supply can make even a tiny cut heal slowly or not at all.
- **Peripheral nerve damage** can cause loss of sensation so you may not notice cuts, sores, or ulcers on your feet.

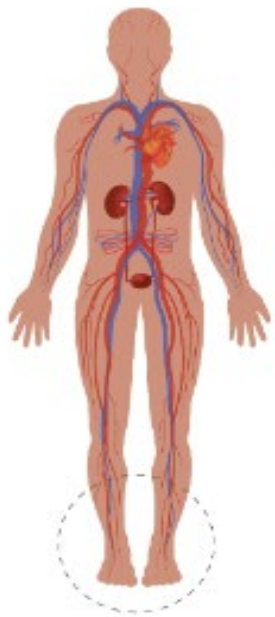
“Pain is the gift that nobody wants” - Dr. Paul Brand

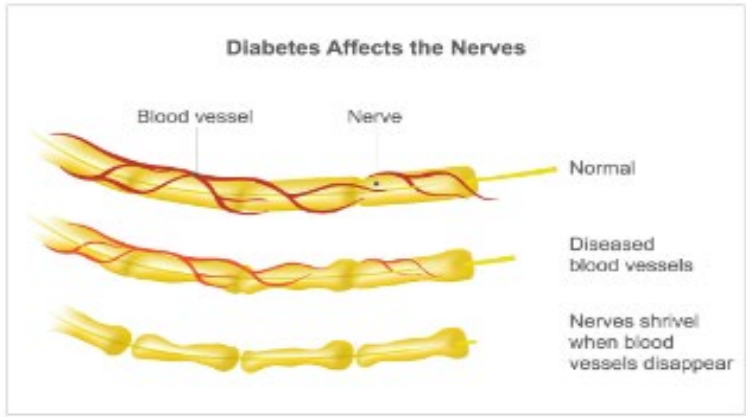
About **50% of patients with critical limb ischaemia** (CLI) the advanced stage of PAD associated with lower-extremi amputation and significant mortality, also have diabetes and they fare worse than non-diabetics.

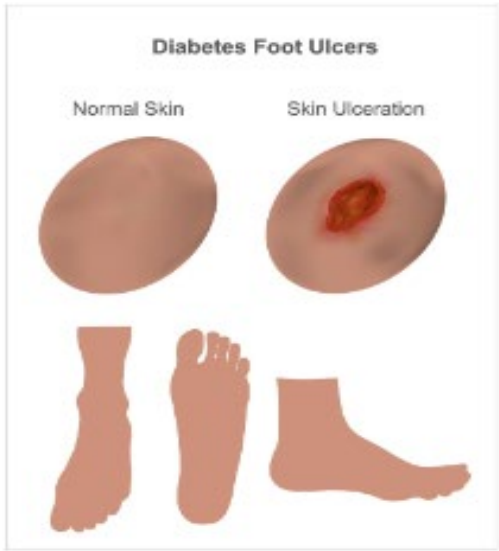


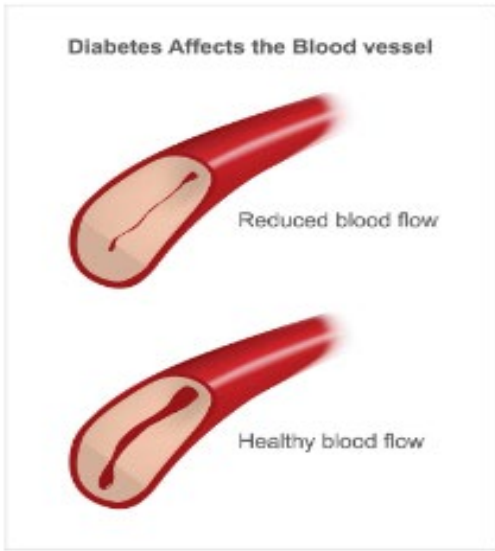
Diabetes Affects

(reduced blood flow and damaged nerve)

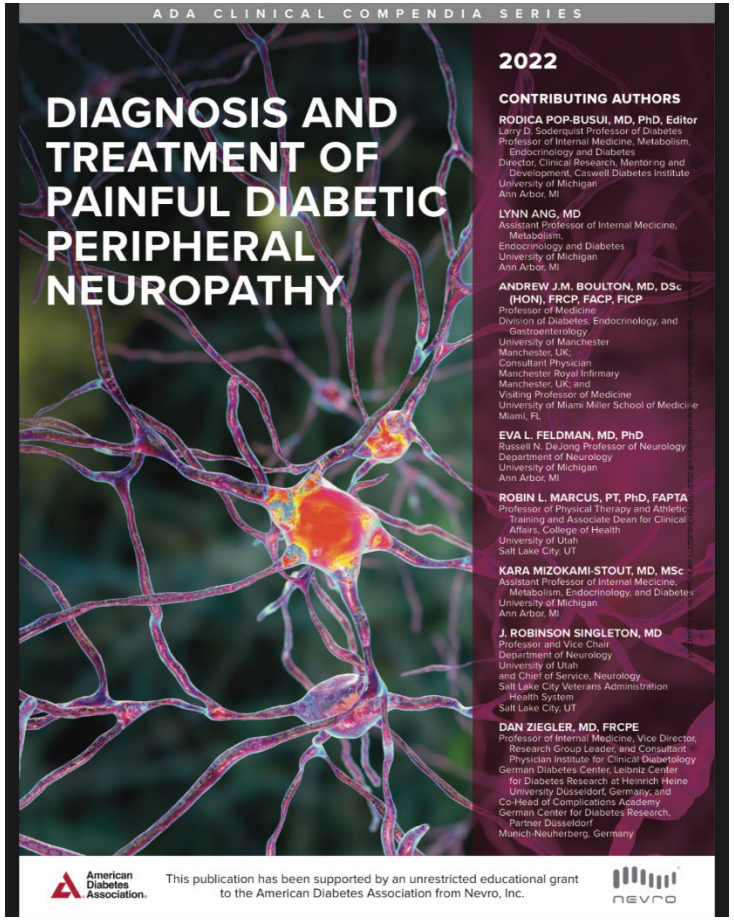




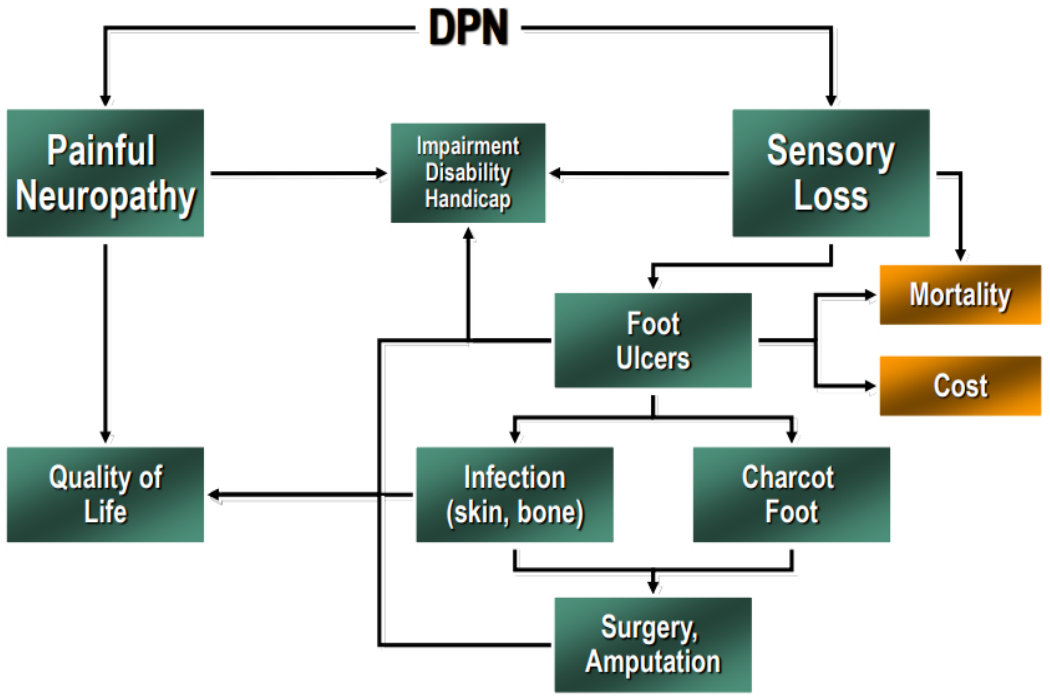




“Pain” versus the “Loss of Sensation”



Clinical Impact of DPN TOTAL Symptoms



Clinical Signs of Diabetic Neuropathy

TABLE 1 Symptoms and Clinical Signs of Diabetic Peripheral Neuropathy

	Symptoms	Function	Signs on examination (clinically diagnostic)*

Large, Myelinated Nerve Fibers	• Numbness
	• Tingling
	• Poor balance
		• Pressure
		• Balance
			• Ankle reflexes:
			  • Reduced
			  • Absent
			• Vibration perception:*
			  • Reduced
			  • Absent
			• 10-g monofilament sensation:*
			  • Reduced
			  • Absent
			• Proprioception:
			  • Impaired

Small Nerve Fibers	• Pain:
	  • Burning
	  • Electric shocks
	  • Stabbing
	• Hyperalgesia
	• Allodynia
		• Nociception
		• Protective sensation
			• Thermal (cold/hot) discrimination:*
			  • Reduced
			  • Absent
			• Pinprick sensation:*
			  • Reduced
			  • Absent

Document impairment/loss in symmetrical, distal-to-proximal pattern.

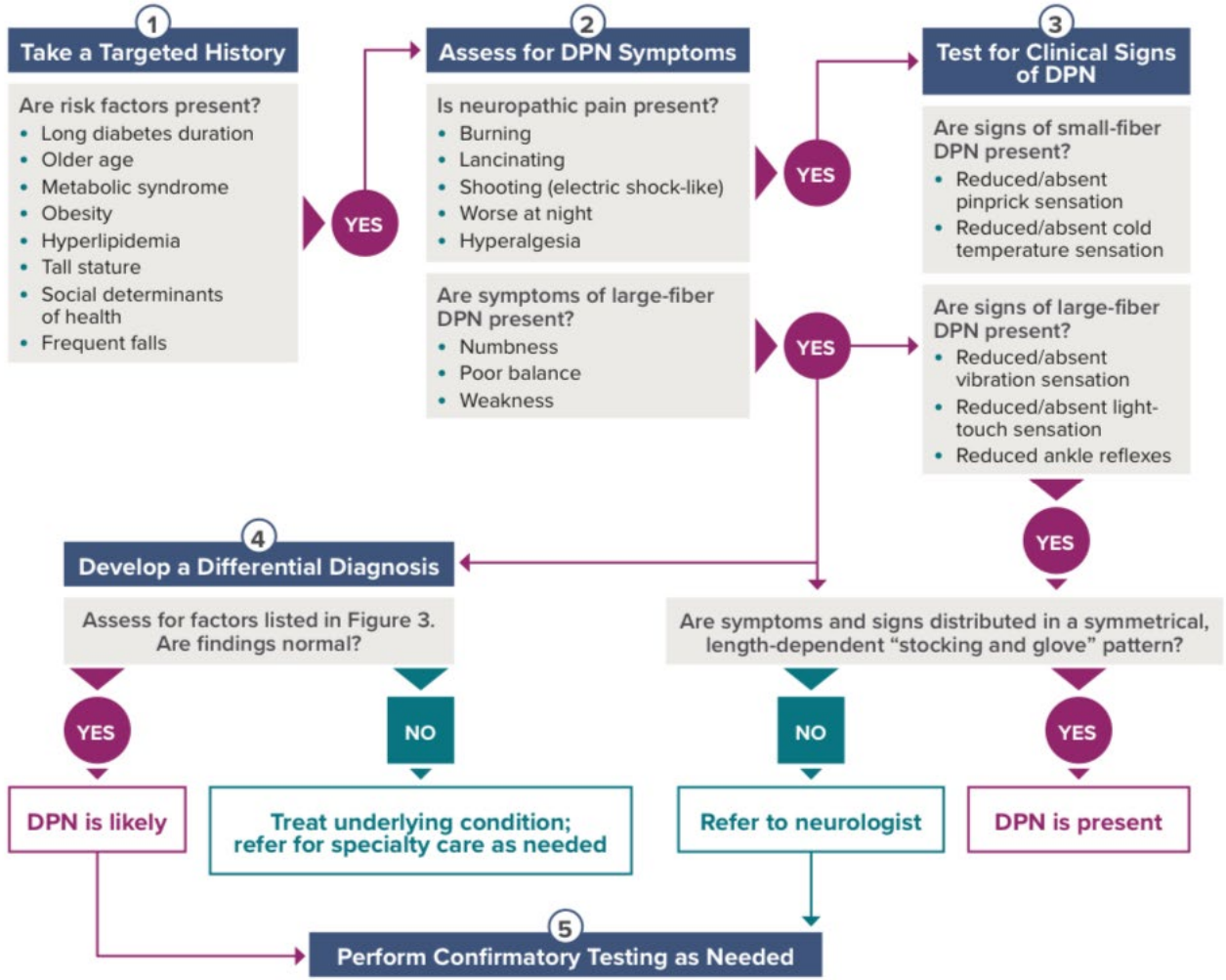
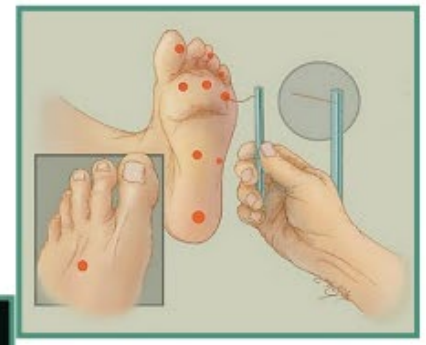


FIGURE 4 A stepwise approach to screening and diagnosing diabetic peripheral neuropathy.

American Diabetes Association - 2022

Diagnostic Tools for DPN:
Large Fiber

- 5.07 Semmes-Weinstein Monofilament
- Biosthesiometer®
- Calibrated Tuning Fork
- Nerve Conduction Velocity



Quatrini C, Boulton A, et al. *Diabetologia*. 2008;51(6):1046-1050.
Boulton AJ, et al. *Diabetes Care*. 2004;27(6):1458-1486.
Boulton AJ, et al. *Prev and Treatment of Diab and its Compli*. 1998;82(4):909-919.
Barber MA, et al. *J Am Podiatr Med Assoc*. 2001;91(10):508-514.
Kiso T, et al. *Journ of Pharmaco and Experi Therap*. 2001;297(1):352-356.

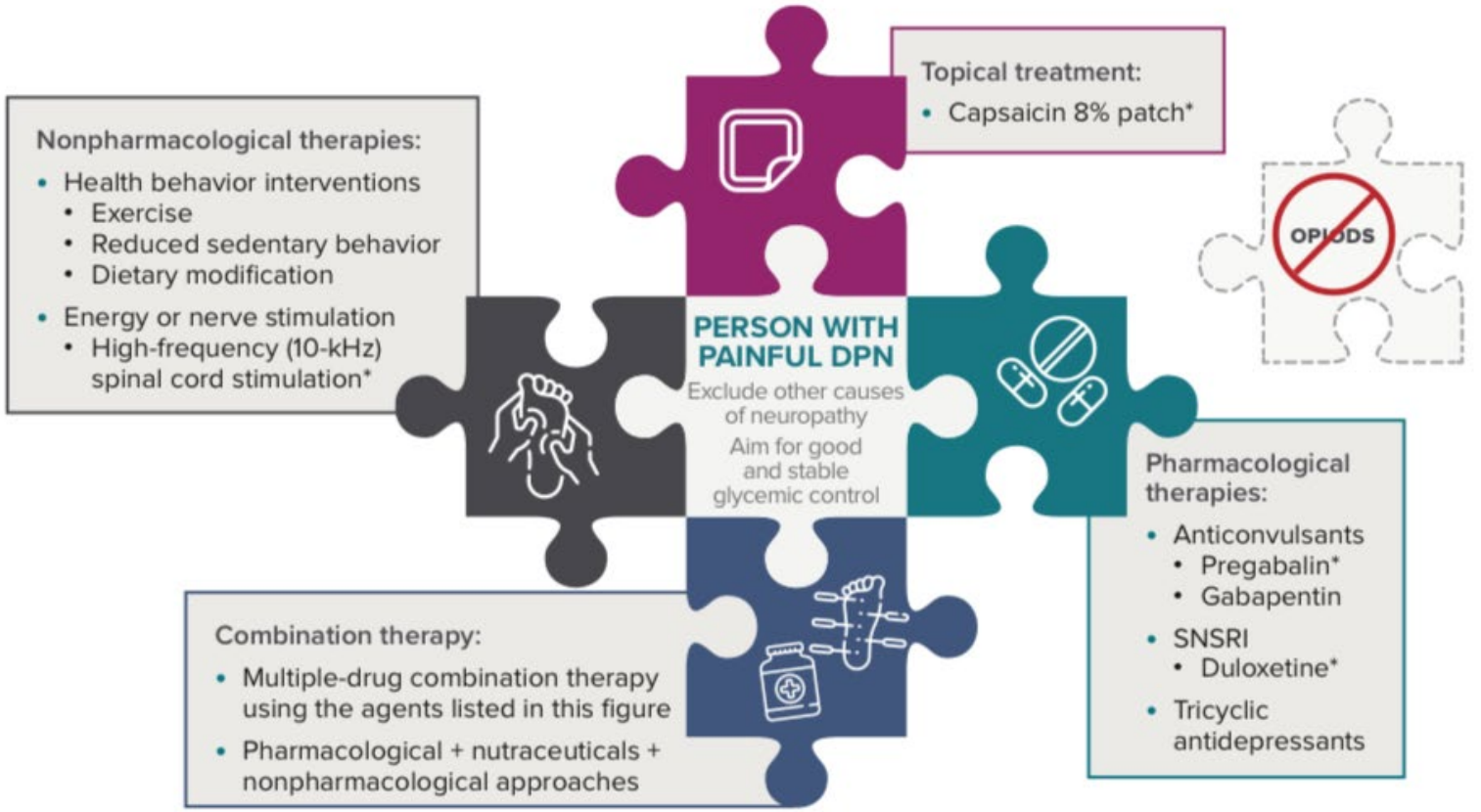
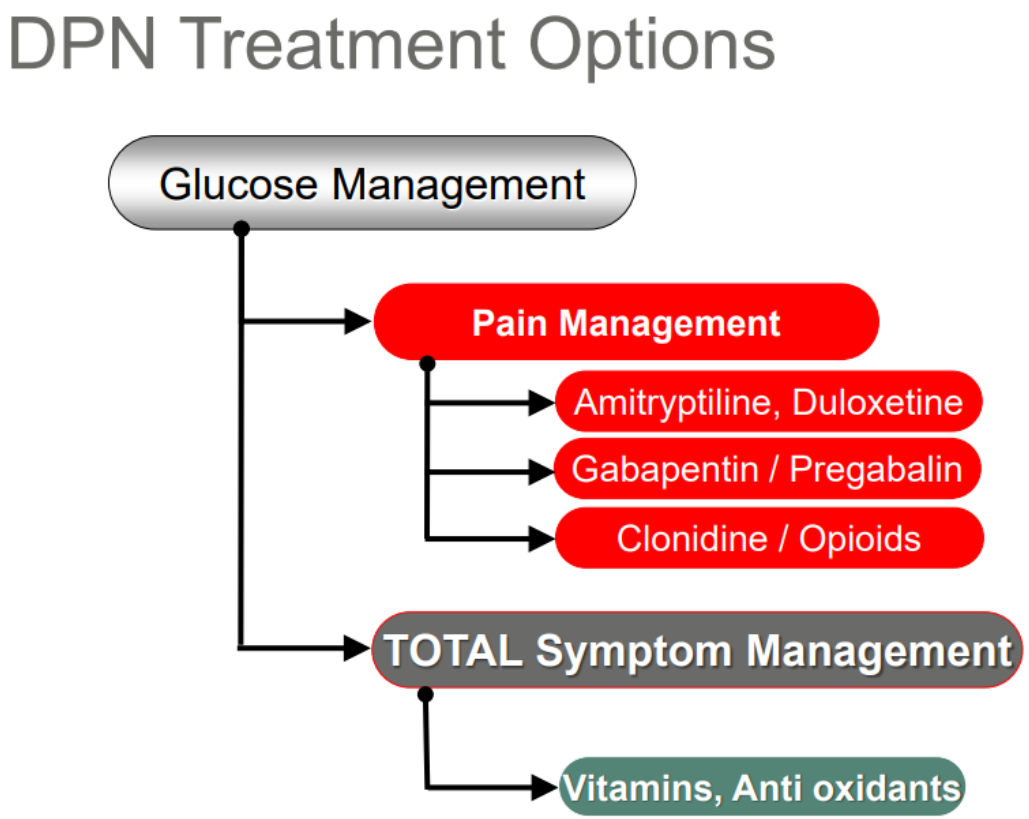


FIGURE 8 Recommended therapeutic approaches to painful diabetic peripheral neuropathy. Pharmacological therapy selection should be individualized based on factors such as comorbidities, cost, potential drug-drug interactions, and potential for adverse effects. Opioids are not recommended because of their high risk of addiction, abuse, and adverse effects. Topical capsaicin and a variety of nonpharmacological approaches are also available, and combination therapy may be needed. Not depicted are the neutraceuticals α-lipoic acid and benfotiamine, which are used in some countries but not approved in the United States. Individuals with severe pain that is refractory to other therapies should be referred to a specialist pain clinic. *U.S. Food and Drug Administration–approved for the treatment of painful diabetic peripheral neuropathy. SNSRI, selective norepinephrine and serotonin reuptake inhibitor.

American Diabetes Association - 2022

Treatment Options for Diabetic Neuropathy

- Pain medications.
- Anti-seizure medications.
- Antidepressants.
- **Topical creams.**
- **Transcutaneous electronic nerve stimulation (TENS) therapy.**
- **Hypnosis.**
- **Relaxation training.**
- **Biofeedback training.**
- **Acupuncture**.



Fonseca V. et al. Poster presented at the 20th Anniversary 2011 American Academy of Clinical Endocrinology Annual Meeting and Clinical Congress
*These data and conclusions should be considered preliminary until published in a peer-reviewed journal.

Reversal of Neuropathic Pain in Diabetes by Targeting Glycosylation of $Ca_V3.2$ T-Type Calcium Channels

Peihan Orestes,[1,3] Hari Prasad Osuru,[1] William E. McIntire,[4] Megan O. Jacus,[1] Reza Salajegheh,[1] Miljen M. Jagodic,[1] WonJoo Choe,[1,6] JeongHan Lee,[1,7] Sang-Soo Lee,[8,9] Kirstin E. Rose,[1] Nathan Poiro,[1] Michael R. DiGruccio,[1,3] Katiresan Krishnan,[5] Douglas F. Covey,[5] Jung-Ha Lee,[8,9] Paula Q. Barrett,[4] Vesna Jevtovic-Todorovic,[1,2,3] and Slobodan M. Todorovic[1,2,3]

▸ Author information ▸ Article notes ▸ Copyright and License information Disclaimer

See "Location, Location, Location?" on page 3658.

Abstract

Go to: ▸

It has been established that $Ca_V3.2$ T-type voltage-gated calcium channels (T-channels) play a key role in the sensitized (hyperexcitable) state of nociceptive sensory neurons (nociceptors) in response to hyperglycemia associated with diabetes, which in turn can be a basis for painful symptoms of peripheral diabetic neuropathy (PDN). Unfortunately, current treatment for painful PDN has been limited by nonspecific systemic drugs with significant side effects or potential for abuse. We studied in vitro and in vivo mechanisms of plasticity of $Ca_V3.2$ T-channel in a leptin-deficient (*ob/ob*) mouse model of PDN. We demonstrate that posttranslational glycosylation of specific extracellular asparagine residues in $Ca_V3.2$ channels accelerates current kinetics, increases current density, and augments channel membrane expression. Importantly, deglycosylation treatment with neuraminidase inhibits native T-currents in nociceptors and in so doing completely and selectively reverses hyperalgesia in diabetic *ob/ob* mice without altering baseline pain responses in healthy mice. Our study describes a new mechanism for the regulation of $Ca_V3.2$ activity and suggests that modulating the glycosylation state of T-channels in nociceptors may provide a way to suppress peripheral sensitization. Understanding the details of this regulatory pathway could facilitate the development of novel specific therapies for the treatment of painful PDN.

Endocannabinoid activation of CB_1 receptors contributes to long-lasting reversal of neuropathic pain by repetitive spinal cord stimulation

L. Sun, L. Tai, Q. Qiu, R. Mitchell, S. Fleetwood-Walker, E.A. Joosten, C.W. Cheung

First published: 20 January 2017 | https://doi.org/10.1002/ejp.983 | Citations: 30

Funding sources

The study was supported by research funding from the Department of Anaesthesiology, the Li Ka Shing Faculty of Medicine, The University of Hong Kong.

Conflicts of interest

None declared.

Read the full text > PDF TOOLS SHARE

Abstract

Background

Spinal cord stimulation (SCS) has been shown to be effective in the management of certain neuropathic pain conditions, however, the underlying mechanisms are incompletely understood. In this study, we investigated repetitive SCS in a rodent neuropathic pain model, revealing long-lasting and incremental attenuation of hyperalgesia and a mechanism of action involving endocannabinoids.

Method

Animals were implanted with monopolar electrodes at the time of partial sciatic nerve injury. Dorsal columns at spinal segments T12/13 were stimulated 3 days later (early SCS), and again at day 7 (late SCS) using low-frequency parameters. Hypersensitivity to cutaneous mechanical stimuli was assessed using von Frey filaments. Pharmacological agents, selected to identify endocannabinoid and opioid involvement, were administered intraperitoneally, 10 min before SCS.

Results

Early SCS caused partial reversal of mechanical hypersensitivity with corresponding changes in the biomarker of central sensitization, [phospho-Tyr^{1472}]-GluN2B. The partial reversal of hyperalgesia by early SCS was amplified by co-administration of LY 2183240, an inhibitor of endocannabinoid reuptake/breakdown. This amplification was inhibited by a CB_1R antagonist, AM251, but not by a CB_2R antagonist, AM630. Early SCS-induced


gettyimages
Nick Dolding

References

1. A Comparison of two diabetic foot ulcer classification systems. Journal of Diabetes Care; January 2001. S.O. Oyibo et al
2. Five year mortality and direct cost of care for people with diabetic foot complications are comparable to cancer. Journal of Foot and Ankle Research; 13, Article number 16 (2020). David Armstrong, Mark Swerdlow, Alexandria Armstrong, Michael Conte, William Padula, Sicco Bus
3. The Risk of Subsequent Amputation Following AN Initial Lowser Extremity Amputation: A Systematic Review. International Journal of Diabetology & Vascular Disease Research; October 26, 2016. Wong CK, Stern JR, Rick F D'Andrea Jr, Loven SL, Panjaki S, See AS, Spinder SJ, Yerovinkina M. Nowygrod R
4. Fate of the contralateral limb after lower extremity amputation. Journal of Vascular Surgery; December 2013. Julia D. Glaser er al
5. Risk of reamputation in diabetic patients stratified ly limb and level of amputation: a 10 year observation. Diabetes Care; 2006; 29(3):566-70. Izumi Y; Satterfield K; Lee S; Harkless LB
6. Endocannabinnoid activation of CB1 receptors contributes to long lasting reversal of neuropathic pain by repetitive spinal cord stimulation; European Journal of Pain, 2017 May. L Sun et al
7. Expensive and Deadly: The Real Cost of Diabetes. American Podiatric Medical Association; November 1, 2014
8. American Diabetes Association - Diabetes Foot Complications. https://diabetes.org

WELL-AHEAD

Project ECHO

Thank You!!!