CASE REPORT

Diet and lifestyle recommendations for the treatment of chronic cough and chronic disease

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SUMMARY

Chronic cough, possibly due to toxicant exposure, may be improved by using a low-risk nutrition-centred strategy. A 71-year-old man experiencing chronic cough for the past 25 years presented to the Cleveland Clinic. In recent years, the patient's cough had increased in frequency and intensity despite pulmonary interventions. The patient's social history revealed exposures as a foundry worker to dimethylethylamine and triethylamine two known respiratory irritants. The patient was placed on a nutrition programme (nutrient dense, low glycaemic index and anti-inflammatory), encouraged to use a sauna each day and placed on nutraceutical supplementation that supports liver detoxification, digestive health and inflammation reduction. Over the course of approximately 1 year, the patient experienced improvement in his cough despite the discontinuation of formal, intensive pulmonary therapy. The patient also experienced weight loss, lower blood pressure and glycaemic status improvement, as well as decreased fatigue and increased energy.

INTRODUCTION

The relationship between occupational exposures, their impact on healthy physiological function and the appearance of chronic disease are often underappreciated.¹ We employed a functional medicine approach that examined an extensive medical history with multiple medical problems to identify lifestyle choices and occupational exposures that adversely impacted this patient's long-term health. This approach offered strategic clues as to how best to restore healthy function. We recommended dietary changes, nutraceutical supplementation, and lifestyle modification, along with conventional medical treatment. Over the course of a year of treatment and follow-up, this patient experienced objective and subjective improvements in health. This case report was prepared according to the CARE Guidelines.²

CASE PRESENTATION**Initial visit (August 2015)**

A 71-year-old man presented to Cleveland Clinic complaining of a 25-year history of cough that had become more frequent and intense over the previous 3 years (figure 1). His cough was characterised by both dryness and intermittent bouts of increased mucous production. It was often exacerbated after consumption of certain foods, seasonal weather changes or exposure to allergens. The coughing

spells usually occurred continuously throughout the day but worsened after lying down. The patient's primary goal for the visit was to reduce or eliminate his chronic cough symptoms.

History

The patient is married with three grown children, all of whom expressed concern for his health. He reported a 20-pack-year smoking history that ended about 25 years ago (figure 1). From 1978 to 1998, the patient worked in aerospace manufacturing company and was exposed to various chemicals including aerosolised aluminium, dimethylethylamine (DMEA) and triethylamine (TEA) (figure 1).

In addition to his chronic cough, the patient also had a 10+-year history of hyperlipidaemia, gout and type 2 diabetes mellitus (T2DM) without use of insulin therapy (figure 1). He reported a family history of cardiovascular disease (father and maternal grandfather, both >55 years old at onset). At his initial visit, the patient indicated the use of multiple medications to manage his T2DM (table 1) as well as the use of a point-of-care glucose monitor.

From 2012 to 2013, the patient had been evaluated by specialists in pulmonology, gastroenterology, allergy and immunology for his chronic cough (figure 1). He was diagnosed with chronic rhinitis and mild pulmonary restriction on pulmonary function testing with normal diffusing lung capacity of oxygen. He also recorded a negative methacholine challenge test. The patient was treated with a course of prednisolone and experienced short-term improvement, but his symptoms returned soon after completion of prednisolone. Numerous other medications that target allergies and inflammation had been ineffective including albuterol sulfate, fluticasone, montelukast, fexofenadine-pseudoephedrine, intranasal triamcinolone acetonide, mometasone and olopatadine. In 2012, the patient sought an initial gastroenterology opinion where an upper gastrointestinal series revealed oesophageal dysmotility, and he was diagnosed with duodenitis. In 2013, the patient underwent oesophageal manometry and was diagnosed with duodenitis and laryngopharyngeal reflux and treated with high-dose omeprazole therapy twice daily for at least 4 months with no significant improvement in his cough. The diagnoses of duodenitis and laryngopharyngeal reflux were not felt to be contributing factors to his chronic cough per his treating physician.

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Figure 1 Medical history timeline. DMEA, dimethylethylamine; TEA, triethylamine.

Initial clinical findings

The patient presented to the Center for Functional Medicine in August of 2015. In addition to his primary symptoms, he was overweight with isolated systolic hypertension (table 2; August 2015). Initial laboratory testing revealed an abnormal high-sensitivity C reactive protein, impaired fasting glucose and well-controlled low-density lipoprotein (LDL) cholesterol levels (table 3; August 2015).

INVESTIGATIONS

Diagnostic assessment

His chronic cough was thought to be secondary to tobacco use and also related to his long-term occupational exposure to DMEA and TEA, in part because previous interventions with steroids and a proton-pump inhibitor had not resolved the cough. In addition, the occupational health literature reports that DMEA, TEA and small silica sand particles produced during

Table 1 Medication and nutraceutical supplementation list

Name	Prior to initial visit	August* 2015	October 2015	December 2015	August 2016
Pioglitazone and metformin	15–500 mg twice daily				
Metformin			500 mg twice daily		
Sitagliptin	100 mg QD				
Colchicine	0.6 mg QD		0.6 mg PRN		
Allopurinol	300 mg QD				
Valsartan	80 mg QD		40 mg QD		
Simvastatin	40 mg QD				
Amitriptyline	10 mg hs				
Aspirin, enteric coated	81 mg twice daily	81 mg QD			
Glucosamine HCL, oral					
Multivitamin (Daily Multiple)	QD				
ALA		QD			
Pyrophyllite healing clay and activated charcoal		QD			
Selenium, milk thistle, NAC, ALA		TID			
Milk thistle, artichoke, turmeric, NAC, ALA, luteolin, ascorbyl palmitate		QD			
Probiotic 50B CFUs (<i>Lactobacillus rhamnosus</i> , <i>Lactobacillus casei</i> and <i>Bifidobacterium bifidum</i>)		QD			
Modified citrus pectin		QD			
Glutathione		QD			
Magnesium citrate		QD			
Omega-3 fatty acids (EPA/DHA)		4600 mg twice daily		3500 mg	

Grey shading denotes use of the medication/supplementation.

*Initial visit.

ALA, alpha-lipoic acid; CFU, colony-forming unit; DHA, docosahexaenoic acid; EPA, eicosapentaenoic acid; hs, hora somni or at bedtime; NAC, n-acetyl-l-cysteine; PRN, pro re nata or as needed; QD, once a day.

Table 2 Biometric and physical examination results

Biometrics	August 2015	October 2015	December 2015	August 2016	March 2017
Height (inches)	70.9				
Weight (kg)	96.16	88.90	83.91	81.65	85.28
BMI (kg/m ²)	29.64	27.43	25.93	25.24	26.97
Blood pressure (mm Hg)	145/67	114/57	103/52	110/51	120/60
Physical examination*					
Mouth—teeth	7 amalgams	7 amalgams	7 amalgams	7 amalgams	
Heart	Somewhat distant, but otherwise regular rate and rhythm without murmur, gallop or rubs. No ectopy				
Lungs	Clear to auscultation. No wheezing or ronchi				
Extremities	Vertical ridging in fingernails	Vertical ridging in fingernails		Vertical ridging in fingernails	

*All other physical examination results were within normal limits.
BMI, body mass index.

Table 3 Laboratory results

Test	Reference range	August 2015	October 2015	December 2015	August 2017	March 2017	November 2017
hsCRP (mg/L)	<1.0	5.4					
Fasting glucose (mg/dL)	65–99	102	89				
Insulin, total (uU/mL)	1–24		5.2				
HbA1c (%)	4.3–5.6		6.3	5.7	6.0	5.8	5.8
Total cholesterol (mg/dL)	125–200	121					
LDL-C (mg/dL)	<130	57					
HDL-C (mg/dL)	≥40	47					
Triglycerides (mg/dL)	<150	83					
Non-HDL-C (mg/dL)	<130	73					
ALT (U/L)	9–46	11					
AST (U/L)	10–35	17					
Vitamin D (ng/mL)	31.0–80.0	41.3					

Bold, abnormal results.

ALT, alanine aminotransferase; AST, aspartate aminotransferase; HbA1c, glycated haemoglobin; HDL-C, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol.

foundry processes can result in respiratory conditions that may present as persistent cough.³

TREATMENT

Recommendations

The patient was placed on an anti-inflammatory, low glycaemic index, nutrient-dense food plan under the supervision of a registered dietitian working in partnership with the treating physician. Nutraceutical supplementation was also recommended to augment gut function and elimination of environmental toxicants (table 1; August 2015). The patient was directed to sit in a dry sauna 30–60 min and drink 3 to 4 L of natural spring water each day. If able, the patient was also encouraged to participate in aerobic exercise such as walking or swimming multiple times each week. Statin therapy was discontinued as a shared medical decision based on the patient's LDL cholesterol results, well-controlled T2DM and concurrent presenting complaint of fatigue and muscle discomfort suggesting statin myopathy.ⁱ

ⁱThe 2013 ACC/AHA Guidelines which state that diabetes is a coronary equivalent were discussed with the patient. The patient had no known personal history of heart disease or early-onset family history of heart disease.

OUTCOME AND FOLLOW-UP

Follow-up and outcomes

Prior to his first follow-up visit, the patient reported fasting morning glucose values in the upper 80s to mid-90s. Based on this information, his sitagliptin was discontinued, but he remained on pioglitazone/metformin combination therapy.

At his first follow-up visit in 6 weeks, the patient reported that his cough was 75% improved. He noted less mucous production and no severe coughing spells for 3 to 5 weeks prior to the date of the follow visit. His wife and other family members also reported noticeably less coughing. Additionally, the patient had lost 7.26 kilograms and lowered his blood pressure during the first 6 weeks (table 2; October 2015). The patient reported low energy and some irritability that he attributed to the food plan and sauna therapy.

Based on the improvement in anthropometric and metabolic measurements (table 2; October 2015), the patient was able to reduce his dose of valsartan and discontinue use of pioglitazone but continued the use of metformin monotherapy (table 1; October 2015). Allopurinol was also discontinued due to absence of gout attacks for 2 years, and the patient was advised to use colchicine as needed for flare ups (table 1; October 2015).

During four sequential follow-up visits, the patient reported continued improvement in his chronic cough. In addition, he continued to lose weight and experience reduction in his blood pressure (table 2). At the December 2015 visit, the patient was

directed to progressively wean off of his supplementation but remains on an omega-3 fatty acid supplement, metformin, valsartan, baby aspirin and colchicine (as needed) (table 1).

At his 1-year follow-up visit in August 2016, the patient reported that his chronic cough symptoms continued to resolve. He maintained his weight loss, reduced blood pressure, adhered to the recommended exercise programme and reported having more energy (table 2; August 2016). The glycated haemoglobin (HbA1c) value reported by his primary care physician was 6.0% with occasional morning glucose values no higher than 115–120 mg/dL (table 3; August 2016). In March 2017, approximately half year after discharge, the patient reported his HbA1c value to be 5.8% (table 3) and has maintained his weight loss and reduced blood pressure (table 2). The HbA1c value of 5.8% was maintained through November 2017 (table 3).

DISCUSSION

The incidence of chronic disease in the USA has become an epidemic due to various factors including poor diet, inactivity, stress and environmental exposures.⁴ This patient's chronic medical problems appeared to be related to many of these factors, and he improved with a functional medicine approach that targeted changes in diet and lifestyle, combined with conventional medications and nutraceutical supplementation.⁵ Our working hypothesis was that a reduction in the inflammatory burden related to a history of occupational exposures, T2DM and cardiovascular disease was likely to respond to an anti-inflammatory diet, nutraceutical supplementation and lifestyle changes. This approach supports a reduction in inflammation and upregulation of metabolic detoxification.⁶

DMEA and TEA are gas catalysts used in the foundry process during core production.⁷ Both compounds along with free silica particulates are made airborne during the foundry process. They have been implicated in various conditions including silicosis and pulmonary fibrosis and can produce abnormalities consistent with reduced pulmonary function testing^{3 8} which this patient had recorded in 2012 (figure 1). DMEA and TEA have deleterious physiological effects on the body when absorbed through the skin and respiratory and gastrointestinal tracts. Dermal exposure to DMEA and TEA can be corrosive to the skin.⁷ Further, when both compounds are aerosolised they can irritate the mucous membranes of the eye and result in visual disturbances.⁷ Additionally, these compounds can irritate the nose or throat and result in cough and respiratory distress.^{3 7} Systemically, these tertiary amines can also initiate the release of histamine from mast cells.⁷

It is pertinent to mention that a chest X-ray in November 2012 was not suspicious for silicosis or pulmonary fibrosis. Ideally, laboratory measurement of DMEA and TEA levels in the body by way of a clinical reference laboratory prior to and following treatment would demonstrate the effectiveness of treatment, but such tests were not available when we saw this patient. Therefore, we sought to manage the patient using a low-risk biotransformation and elimination strategy (table 4) focused on the improvement of his chronic cough symptoms.

The patient was placed on an anti-inflammatory, low glycaemic index, nutrient-dense food plan under the supervision of a registered dietitian working in partnership with the treating physician. Nutraceutical supplementation was employed as an adjunct to nutritional recommendations to improve micronutrient levels.⁹ The food plan encouraged the consumption of fresh, non-processed foods (mostly vegetables), and the elimination of highly processed foods and foods

containing dairy, sugar and gluten. This food plan works to optimise the function of the gut, improve phase I and phase II detoxification processes and reduce the inflammatory burden on the immune system.¹⁰ The food plan also supported insulin sensitisation and in this patient resulted in appropriate weight loss.^{11–13}

The beneficial effects of plant-based nutrition for the prevention and treatment of chronic conditions such as obesity, T2DM, cardiovascular disease and hypertension are well documented.^{14 15} While the patient was not on a strict vegetarian diet, he was encouraged to eat fresh, bright-coloured vegetables and low glycaemic index fruits. Both contain large amounts of fibre and phytonutrients which have been shown to improve insulin resistance¹⁵ and reduce inflammatory status.¹⁶ In addition, the consumption of fibre from fruits may reduce the incidence of chronic respiratory symptoms (ie, cough with phlegm)^{17 18} and improve pulmonary function.¹⁸

Thermal depuration, or sweating, is an essential lifestyle recommendation and has many positive effects. Sweating mimics the physiological effects of exercise,¹⁹ facilitates the removal of environmental toxins from the body²⁰ and improves function in those with respiratory conditions.²¹ Once the patient felt well enough to exercise, he was able to reduce the frequency of visits to the sauna.

An extensive medical history and detailed timeline reveals many factors that may influence a patient's long-term health and the development of chronic disease. This may help identify proximal causes of chronic disease that can give rise to low-risk, high-impact treatment strategies. In addition, therapies that leverage and support the body's intrinsic resilience mechanisms—particularly nutrition—may promote sustainable health and wellness.

CONCLUSION

This case illustrates how a low-risk approach that leverages nutrition and lifestyle changes may support the self-healing capacities of the body. Given the patient's occupational exposure history,

Table 4 Biotransformation and elimination strategy

Supporting detoxification	Recommendation
Minimise exogenous toxic exposure	Eat fresh, non-processed, organic (if possible) foods.
Ensure adequate hydration	Increase water intake to facilitate expulsion of toxicants.
Promote healthy toxin binding and excretion	Pyrophyllite healing clay and activated charcoal as toxicant binders. Use magnesium citrate to facilitate expulsion of toxicants via stool.
Gastrointestinal microbiological restoration/ balance	Supplement with modified citrus pectin and a prebiotic/probiotic.
Assist and balance endogenous biotransformation of toxicants	Ensure adequate protein source for enzyme production. Supplement with NAC and ALA (conjugate precursors for phase II reactions) as well as vitamin B ₁₂ , selenium and milk thistle (enzymatic cofactors for phase I and phase II reactions).
Increase sweating	Use a dry sauna and increase aerobic/anaerobic exercise.
Enhance antioxidants	Supplement with NAC and ALA and consume fresh, colourful foods.
Downregulate inflammation with essential fatty acids	Supplement with omega-3 fatty acids.
ALA, alpha-lipoic acid; NAC, n-acetyl-L-cysteine.	

previous evaluations and interventions, we hypothesised that his respiratory exposure to DMEA and TEA may have been, in part, responsible for his cough. In addition, benefits of a treatment strategy that focuses on nutrition may extend beyond an individual's chief complaint positively impacting multiple domains of health.

Patient's perspective

For 25 years I lived with a chronic cough. Since I began the programme with Functional Medicine, I've reduced my chronic cough by 85%. By going gluten-free and also following a very controlled diet I've lost 55 pounds and gained control of my blood sugar count. I have also reduced my prior medications by 50%.

Learning points

- ▶ A functional medicine approach may lead to better outcomes in alignment with a patient's healthcare goals. This low-risk approach leverages nutrition and lifestyle changes to support the self-healing capacities of the body.
- ▶ Occupational exposures may contribute to chronic cough, physiological dysfunction and complex, chronic disease.
- ▶ Low-risk nutritional interventions along with nutraceutical supplementation that support biotransformation and elimination may be beneficial for patients with chronic cough secondary to occupational exposures.

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