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Patient With Sitosterolemia With Slow Healing Sternal Wound From Coronary Artery Bypass Surgery

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ABSTRACT

BACKGROUND: Sitosterolemia, also known as phytosterolemia, is a rare recessive genetic disorder characterized by accumulation of sitosterol from vegetable oils, nuts, and other plant-based foods in the body. In those with sitosterolemia, there is an increase of fatty deposits in the arteries (atherosclerosis), which may occur in early childhood, impeding blood flow and increasing the risk of a heart attack, stroke, or sudden death at a very early age. Visual signs of sitosterolemia may include small yellowish xanthomas beginning in early childhood. Xanthomas are accumulated lipids that develop in the heels, elbows, and buttocks.

CASE: A clinical case study of a patient with sitosterolemia with slow healing surgical wound from coronary artery bypass surgery is described. Treatment of sitosterolemia is aimed at lowering plasma plant sterol levels with dietary restriction intake of both animal- and plant-based sterols. However, plant-based products (collagen, chitosan, etc) are also used for wound dressings, so alternative wound dressings were selected to decrease the possibility of systemic absorption.

CONCLUSION: This case study describes a young adult male with sitosterolemia who presented with a slow healing surgical incision following coronary artery bypass surgery. Sitosterolemia is often characterized by atherosclerosis of the coronary arteries that occurs in children and early adulthood, especially affecting men. Treatment is aimed at lowering plasma sterol levels with the restriction of animal and plant sterols. There is considerable interest today in natural versus synthetic wound care products. Dressings containing chitosan, cellulose, collagen, etc, to be avoided to decrease the chance of systemic absorption.

KEY WORDS: Phytosterolemia, Plant sterol, Sitosterolemia, Sternal wound dehiscence, Wound healing, Xanthomas.

INTRODUCTION

Sitosterolemia is a rare lipid disorder that differs from familial hypercholesterolemia. It was first described in 1974 by Bhattacharyya and Connor,[1] who reported 2 sisters who presented with elevated levels of plant sterols with extensive tendon and subcutaneous xanthomas present since childhood despite normal levels of cholesterol. The authors proposed that in some way the plant sterols initiated the development of xanthomas since there were normal plasma cholesterol levels.[1]

Sitosterolemia, also known as phytosterolemia, is an autosomal recessive disorder (inherit 2 mutated genes; one from each parent). It is caused by mutations in *ABCG5* or *ABCG8* genes that play an important role in the excretion of plant sterols from the liver and the intestine, leading to failure to prevent absorption of food plant sterols.[2-4] The prevalence of sitosterolemia has been estimated to be 1 in 160,000.[3] This number is probably underestimated as mild cases are likely undiagnosed. Men and women are equally likely to have sitosterolemia, and anyone with this condition is affected from birth.

Plant sterols (sitosterol, campesterol, and stigmasterol) are not produced by the body but occur naturally at low levels in plants such as vegetable oils, margarine, fruits, vegetables, legumes, nuts, seeds, and cereals.[3,4] Increased absorption of plant sterols from the intestine and the decreased secretion from the liver are the primary causes of sitosterolemia. Sitosterol is typically the most abundant plant sterol in the diet, but it is not synthesized in the body like cholesterol.[5] It is characterized by hyperabsorption of sitosterol from the gastrointestinal tract, decreased hepatic secretion of sitosterol, and altered cholesterol synthesis. The routine laboratory test for measuring plasma concentration of cholesterol does not measure plant sterols. A patient's cholesterol varies greatly with diet, but does not respond well to statins, raises a suspicion of sitosterolemia.

A serum level of sitosterol 1 mg/dL or more (10 μg/mL) is considered diagnostic.[4] Some individuals may have levels 30 to 100 times normal. Cholesterol is mildly to moderately elevated in sitosterolemia. However, some people have normal cholesterol levels. The key to reducing the concentration of sitosterol in blood and tissue is to reduce absorption and increase excretion.[2] Hematological abnormalities associated with sitosterolemia include hemolytic anemia and macrothrombocytopenia. Those with sitosterolemia may also complain of joint stiffness and arthritic pain.

In persons with long-standing untreated sitosterolemia, noninvasive imaging is used to exclude coronary and carotid atherosclerotic plaques, as well as heart valve atherosclerotic disease.[6] The atherosclerosis increases the risk of heart attack, stroke, or sudden death at an early age. In young adults, especially men, the atherosclerosis of sitosterolemia often occurs in the coronary arteries. Some with sitosterolemia develop small yellowish growths called xanthomas beginning in childhood.

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The author has no conflicts of interest to declare.

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Xanthomas are accumulated lipids (cholesterol deposits) frequently located on the Achilles tendons, heels, elbows, and buttocks.

Treatment is aimed at lowering plasma plant sterol levels. Interventions may include dietary restrictions of the intake of animal- and plant-based sterols, use of bile acid sequestrants (cholestyramine), and prescribing sterol absorption inhibitors (ezetimibe). If unresponsive to medication and dietary restriction, partial ileal bypass surgery may be considered to increase intestinal bile acid loss.[2,6] Follow-up surveillance includes annual laboratory surveillance of plasma concentrations of plant sterols (primarily sitosterol and campesterol), cholesterol, complete blood cell count, platelet count, and liver transaminases. Assessment of the size, number, and distribution of xanthomas is monitored because often they will regress with treatment of sitosterolemia.

CASE PRESENTATION

A 22-year-old male patient presented with hyperlipidemia, elevated liver enzymes, shortness of breath (SOB), and chest pain. He had a positive family history of coronary artery disease (CAD), including a grandfather who died at the age of 41 years of a heart attack. His lipid panel on admission showed low-density lipoprotein (LDL) cholesterol of 240. He also had elevated liver enzymes and was seen by gastroenterology for transaminitis. He had recently been on a vegetarian diet. He did not smoke or drink alcohol. On physical exam, he was noted to have xanthomas on both elbows and Achilles tendons, which suggested the presence of familial hypercholesterolemia disorder.

He was admitted to hospital and diagnosed with NSTEMI (non-ST-elevation myocardial infarction) and underwent a coronary artery bypass graft (CABG) surgery of 3 coronary blood vessels. Genetic testing was positive for 2 disease-causing *ABCG8* gene variants associated with sitosterolemia that explained the advanced CAD with a history of NSTEMI. He was seen by a registered dietician who reviewed dietary restrictions of plant sterols including a diet low in shellfish and plant sterols (eg, vegetable oils, margarine, nuts, seeds, olives, avocados, and chocolate). He was prescribed ezetimibe 10 mg tablet daily. Cholestyramine was not prescribed due to his elevated liver enzymes.

Three weeks after the procedure, he presented to the clinic with SOB and persistent serous drainage from his surgical incision, as well as slough in the wound bed (Figure). He was readmitted to the hospital and underwent a thoracentesis for a pleural effusion and sharp surgical debridement of the sternal wound with placement of negative pressure wound therapy (NPWT). He was given intravenous antibiotics during hospitalization and then transitioned at discharge to oral antibiotics for 7 days. Wound cultures were negative. Home health was established to assist with the management of the NPWT. However, he discontinued the NPWT several days after discharge because of chest discomfort. Home health subsequently discharged him. He was performing wet-to-dry saline dressings to the chest wound twice daily when seen in the clinic.

On assessment by the WOC nurse in the clinic, the wound measured 14 × 0.8 × 0.4 cm and was covered with hypergranulation tissue. The wet-to-dry dressings kept the wound too moist. Chemical cauterization was performed on the hypergranulation tissue over the incisional wound. There was a large amount of serosanguinous drainage without overt signs of infection/cellulitis. The periwound was intact.

Figure. Surgical incision prior to debridement.

In developing the optimum wound management program for the patient, many factors were considered such as etiology, condition of periwound, size and depth, wound location, volume of exudate, presence of infection, and eliminating contact of plant sterols with the wound surface. Dressings may be classified as traditional (eg, gauze, petroleum gauze), natural derived (eg, collagen, chitin and chitosan, alginate, animal-derived skins such as pig skin or fish skin), and synthetic (eg, hydrogel, film, foam) dressings. For the patient with sitosterolemia, I recommend avoiding dressing that contain shellfish (eg, chitin and chitosan) and plant sterols (eg, cellulose, collagen, and alginate) because they might be absorbed systemically.[7] Product categories and products within categories were reviewed to ensure avoidance of sterols. The US Food and Drug Administration requires a basic level of disclosure for wound products, which was also reviewed. A super absorbent dressing (Drawtex; Urgo Medical, Fort Worth, Texas) was selected due to the large amount of drainage. He was instructed to change it daily after showering. He was set up for weekly wound assessments in the clinic.

Three weeks later in the clinic visit, the midline chest incision measured approximately 8 × 0.6 × 0.2 cm with red granulation tissue and a small amount of serosanguinous drainage. No overt signs of infection were present. He complained of the dressing sticking to the wound. A hydrogel (PluroGel; Medline Industries, Northfield, Illinois) was prescribed to promote a moist wound healing environment and covered with a bordered postoperative dressing (Mepilex; Mölnlycke Health Care, Gothenburg, Sweden). He continued to dress the wound with the hydrogel dressing daily after showering. He was seen in the clinic for weekly wound

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assessments, with smaller wound measurements documented at each visit. Approximately 14 weeks after the CABG surgery, the incision closed.

DISCUSSION

Sternal wounds may range from superficial (involving the subcutaneous or soft tissue but not the mediastinum) to deep (those involving the mediastinum and cartilage/bone). My patient experienced superficial dehiscence of the sternal incision approximately 2 weeks after the CABG surgery. More than 20 different causes have been cited in the literature that may directly or indirectly affect the incidence of sternal dehiscence.[8] It has been established that this complication develops more frequently in men due to the musculature of the chest.[9]

Knowledge of available wound dressing products and clinical expertise in dressing selection are important aspects of wound management. Selection should be based primarily on the assessment of the wound, but there are other factors that may affect dressing selection of the wound such as the patient's disease process. Plant-based sterols promote wound healing,[7] but I found research indicating those with sitosterolemia have poor wound healing due to the dietary restriction of plant-based sterols.

Sitosterolemia is a relatively rare lipid metabolism disorder that is underdiagnosed. It should be suspected in individuals (children and young adults) with hypercholesterolemia who show response to low fat diet (low saturated fat/low cholesterol/low plant-derived foods) or to bile acid sequestrants (cholestyramine) therapy, xanthomas (childhood) in pressure point locations (heels, knees, elbows, buttocks), hemolytic anemia, and premature atherosclerosis.[6] The majority of patients with sitosterolemia are diagnosed in the setting of dyslipidemia with high LDL cholesterol with or without complications such as xanthomas or cardiovascular complications.

The xanthomas seen with sitosterolemia are located over pressure areas such heels, knees, elbows, and buttocks, which are areas that are frequently assessed in pressure injury prevention programs. Health care providers need to be educated on the distinguishing characteristics of xanthomas versus pressure injury and the timeline of presentation as many xanthomas have been present since early childhood. In the case study, the patient presented with high LDL cholesterol, elbow and Achilles xanthomas, and sustained a heart attack at the age of 22 years, necessitating a CABG surgery.

The routine clinical test for measuring plasma concentration of cholesterol does not measure plant sterols; therefore, sitosterolemia is likely to be underdiagnosed. Men and women are equally likely to have sitosterolemia, and anyone with this condition will have had it since birth, although many are not diagnosed until later in life. The patient in the case study was diagnosed at the age 22 years. Ongoing surveillance for this patient and others with sitosterolemia includes blood levels of plant sterols and cholesterol. Additionally, the size, number, and distribution of xanthomas should be assessed annually. Surveillance for atherosclerosis disease including CAD is strongly recommended.

Reasonable selection of the appropriate dressings is an important issue for the management of all wounds. Dressings may be classified as traditional (eg, gauze, oil emulsion dressing), natural derived (eg, collagen, chitin and chitosan, alginate, animal-derived skins such as pig skin or fish skin), and synthetic (eg, hydrogel, film, foam) dressings.[10] Dressing selection for the patient with sitosterolemia included avoiding any dressing that might contain shellfish (eg, chitin and chitosan) and plant sterols (eg, cellulose, collagen, and alginate) that could potentially be absorbed systemically through the wound.[7]

Determining the best wound dressing is based on the accurate assessment of the wound and the patient. In the patient in this case study, finding the appropriate wound dressing was challenging and involved reviewing the ingredients of specific wound dressings to make sure that they did not include any natural derived shellfish or plant extracts that may be absorbed into the wound, possibly delaying healing. This limited the dressing selection for this patient to dressings that were more traditional because they needed to be nonplant-based.

CONCLUSION

This case study describes a 22-year-old male patient who was diagnosed with sitosterolemia with resultant severe atherosclerotic heart disease necessitating a CABG surgery. He developed dehiscence of the surgical incision, necessitating the WOC nurse to be consulted for wound care recommendations. Alternative wound dressings not containing plant-based sterols were selected to decrease the possibility of systemic absorption of these plant sterols through the open wound. Research is needed to confirm or disprove systemic absorption of wound products through an open wound.

KEY POINTS

- Sitosterolemia is characterized by accelerated atherosclerosis, which increases the risk of heart attack, stroke, or sudden death at a very early age.
- Dietary intake of plant-based sterols has been shown to stimulate wound healing, but they are contraindicated in those with sitosterolemia, as it may increase their risk for poor wound healing.
- In those with sitosterolemia with wounds, one should consider a dressing that does not contain natural shellfish and plant-based products that could be absorbed into the wound.
- Research on systemic absorption of wound dressing ingredients is needed.

REFERENCES

1. Bhattacharyya AK, Connor WE. Beta-sitosterolemia and xanthomatosis. A newly described lipid storage disease in two sisters. *J Clin Invest*. 1974;53(4):1033-1043. doi:10.1172/JCI107640.
2. Su SQ, Xiong DS, Ding XM, Kuang JA, Lin YC. Pediatric patients with familial inherited sitosterolemia: two case reports. *Front Cardiovasc Med*. 2022;9:927267.
3. Tada H, Kojima N, Takamura M, Kawashiri MA. Sitosterolemia. *Adv Clin Chem*. 2022;110:145-169.
4. Tada H, Nomura A, Ogura M, et al. Diagnosis and management of sitosterolemia 2021. *J Atheroscler Thromb*. 2021;28(8):791-801. doi:10.5551/jat.RV17052.
5. Salen G, Shefer S, Nguyen L, Ness GC, Tint GS, Shore V. Sitosterolemia. *J Lipid Res*. 1992;33(7):945-955.
6. Myrie SB, Steiner RD, Mymin D. Sitosterolemia. April 4, 2013 [updated July 16, 2020]. In: Adam MP, Mirzaa GM, Pagon RA, et al., eds. *GeneReviews®*. Seattle, WA: University of Washington, Seattle; 1993-2024. https://www.ncbi.nlm.nih.gov/books/NBK13. Accessed February 9, 2024.

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7. Peng W, Li D, Dai K, et al. Recent progress of collagen, chitosan, alginate and other hydrogels in skin repair and wound dressing applications. *Int J Biol Macromol*. 2022;208:400-408. doi:10.1016/j.ijbiomac.2022.03.002.
8. Al Salmi H, Elmahrouk A, Arafat AA, et al. Implementation of an evidence-based practice to decrease surgical site infection after coronary artery bypass grafting. *J Int Med Res*. 2019;47(8):3491-3501. doi:10.1177/0300060519836511.
9. Verrillo SC. Negative pressure therapy for infected sternal wounds: a literature review. *J Wound Ostomy Continence Nurs*. 2004;31(2):72-74. doi:10.1097/00152192-200403000-00006.
10. Croitoru AM, Ficai D, Ficai A, Mihailescu N, Andronescu E, Turculet CF. Nanostructured fibers containing natural or synthetic bioactive compounds in wound dressing applications. *Materials (Basel)*. 2020;13(10):2407.

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