AQK exclusively affecting the soles

Most instances of aquagenic keratoderma affect the hands as well as the feet; the two cases described here were unusual in that only the plantar surface was involved.

Aquagenic keratoderma (AQK) is a striking but rare skin disorder, most frequently observed in young adults. It presents as rapid wrinkling of the palms and soles when exposed to water, and may be accompanied by pain or itching. The aetiology is unclear, but associations with specific drug therapies and cystic fibrosis are known to exist. The authors present two unusual cases exclusively affecting the plantar surface (unilaterally and bilaterally).

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Conflict of interest:
none declared

Case presentation

Patient A was a 28-year-old male. His chief concern was being embarrassed by his feet, which he described as becoming 'soggy' whenever he got them wet when swimming or bathing. He found it particularly difficult on holiday, after swimming in the pool. He described the condition as beginning in his teenage years, but said it had not really improved or deteriorated since. He had sought help from his doctor but no diagnosis had been made or treatment offered. His general health was excellent. He was a non-smoker with a normal BMI of 24. He was receiving no medication, and had no history of significant illnesses or family history of disease. Upon examination, his vascular and neurological status were within normal limits. The plantar skin on both feet showed slight hyperhidrosis; no hyperkeratosis was evident but there was some evidence of previous exfoliation (Figures 1a and 1b). The nails appeared normal and there were no problems with the palms. There was no evidence of tinea pedis or onychomycosis. The patient provided an image of his feet immediately after showering (Figure 2).

Patient B was a 22-year-old male, who contacted his podiatrist via email during the Covid-19 pandemic, troubled by 'unusual changes' on the sole of his right foot only, which occasionally itched. It was at its worst after showering. He was fit and well, with no

FIGURE 1

Patient A at presentation while the skin was dry, showing only limited exfoliation

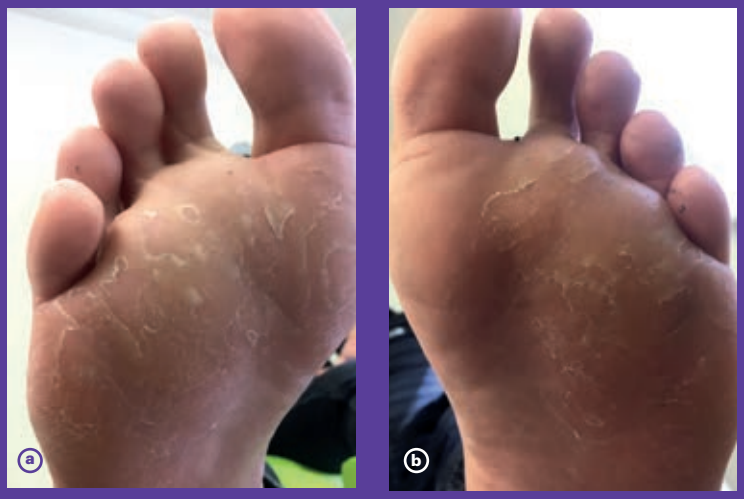
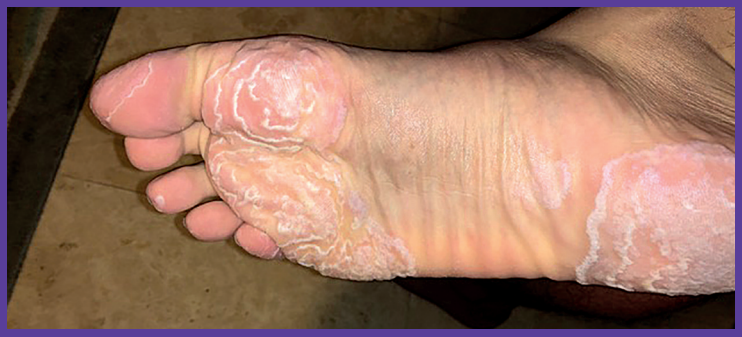


FIGURE 2

Patient A plantar surface immediately after water exposure



significant medical or family history. His palms were unaffected. Emailed pictures of his foot (Figures 3a, 3b and 3c) showed plantar skin exfoliation and hyperkeratosis. He had been using potassium foot soaks daily for five minutes with little effect.

Following the assessment, a diagnosis of AQK was made for both patients. Treatment initially consisted of basic advice: regular washing and thorough drying of the feet. The patients were advised to use antiperspirants on the soles of their feet, twice daily. At a follow-up, four weeks later, patient A had noticed an improvement in the problem, but it still was evident after bathing. Following discussion with the patient, he was referred to his GP, recommending a referral to the local dermatology department, with a view to receiving a course of iontophoresis. Patient B had little response to the antiperspirants and was due to return for a further consultation with his podiatrist after the first lockdown (March to June 2020), with a view to being referred to the dermatology department for further assessment and treatment.

Both patients have given consent for use of their histories and images in this paper.

Discussion

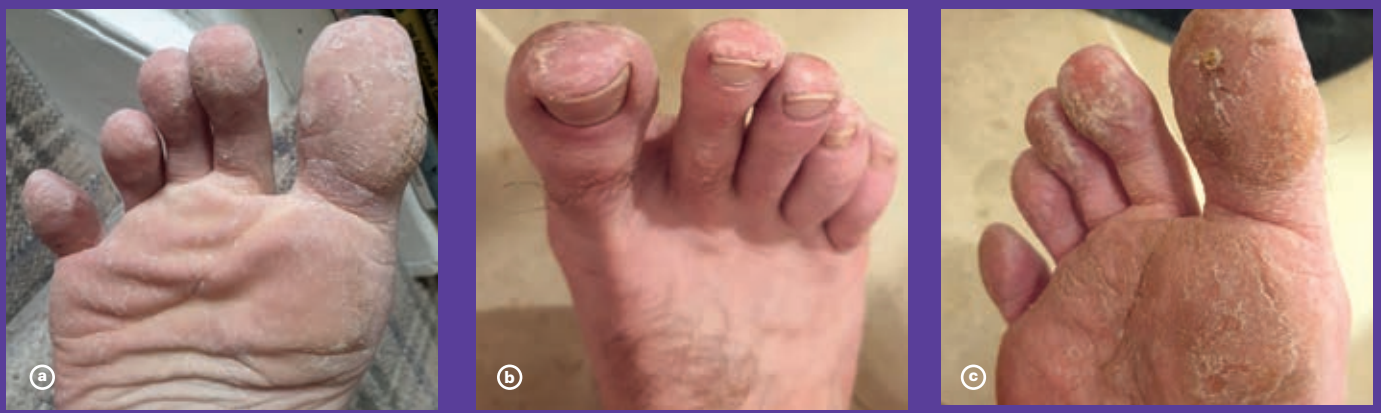
AQK (also known as transient aquagenic hyperwrinkling, transient reactive papulo-translucent acrokeratoderma, and aquagenic syringeal acrokeratoderma) is a rare skin condition. It is characterised by the rapid development of transient, oedematous papules and plaques on the palms of the hands and soles of the feet within minutes of immersion in water. Involvement of the palms is a significant feature of the condition (Megna et al, 2016; Glatz and Muellegger, 2014; Halsey et al, 2011; Davis and Woody, 2004); we present two cases that exclusively affect the plantar surface: an unusual finding in the literature (Xia, 2012).

AQK was first described in 1996 by English and McCollough, reporting two sisters who developed what they termed 'transient reactive papulotranslucent acrokeratoderma', or AQK, exclusively on the palms, which appeared after just three to five minutes' immersion in water, and resolved quickly after drying (English and McCollough, 1996). The authors describe how the condition was accompanied by the sensation of tightening as the wrinkles developed. Since then, dozens of cases have been reported in the medical literature. Predominantly, the condition presents symmetrically, typically on the palms and to a lesser extent on the soles of the feet (Ertürk-Özdemir et al, 2015) around puberty. Unilateral presentations (Ibusuki et al, 2012; Houle et al, 2010; Khuu et al, 2006) and accompanying symptoms of pruritus and pain have also been recorded (Kim et al, 2015). The condition has been reported both as sporadic and familial cases (Nazik et al, 2016).

The diagnosis of AQK is made purely on clinical grounds. In unaffected subjects, research has shown that immersion in water leads to wrinkling in around 11 minutes (Tsai and Kirkham, 2005); for those affected with AQK, wrinkling typically occurs within three minutes of exposure (Gild et al, 2010). Upon drying, the condition resolves, normally within an hour. Histologically, skin samples from wrinkled areas have demonstrated hyperkeratosis of the stratum corneum and acantholysis accompanied by dilated sweat ducts (Xia, 2012), visible under dermoscopy (Gualdi et al, 2016; Sezer et al, 2012). Clinically, the condition should be distinguished from hereditary papulotranslucent acrokeratoderma (HPA). This is a rare autosomal dominant condition characterised by translucent papules and plaques on the hands and feet – typically they occur on the weight-bearing surfaces of the soles and are unaffected by water immersion. A family history of the condition – which does not change when the

FIGURE 3

Patient B showing wrinkling of the sole (a), apices of toes (b) and residual wrinkling shortly after drying, with hyperkeratosis (c)



foot or hand is immersed in water – is suggestive of HPA over AQK. In addition, HPA is accompanied by fine scalp hair and a predisposition to atopic disease in patients (Onwukwe et al, 1973).

From published research, it would seem that many cases of AQK are associated with hyperhidrosis, Raynaud's phenomenon, cystic fibrosis (CF) and specific medications (Gualdi, 2016). CF is an autosomal recessive disorder resulting from a mutation in the cystic fibrosis transmembrane regulator gene, leading to impaired transport of chloride across epithelial membranes. Association with the condition was reported around 50 years ago, when it was observed that many children with CF had rapid wrinkling of their palms when these were immersed in water, compared with children without the condition (Elliott, 1974). One study of known CF patients demonstrated that time to wrinkling was around three minutes when compared with known CF carriers (seven minutes), and 11 minutes in those without the gene, although not all CF patients show the condition on water immersion. It has been suggested between 44% and 80% of CF patients have AQK (Kaiser et al, 2018; Tchernev et al, 2014). Consequently, it has been proposed that patients presenting with AQK should be offered screening for both CF (homozygous) and heterozygous carrier state (Gild et al, 2010).

This potential link was discussed with both patients in the current case study, and was communicated to their GPs for follow-up. Although neither patient was taking any medication, drugs that have been associated with AQK include cyclo-oxygenase (COX-2) inhibitors (Akin Belli and Dogan, 2016; Carder and Weston, 2002), paracetamol (Glatz and Muellegger, 2014), spirolactone (Uyar, 2014), indomethacin (Gualdi et al, 2016) and aspirin (Khuu et al, 2006).

The pathophysiology of AQK remains incomplete, although observations and studies have led to the development of hypotheses. It has been shown that patients with CF produce more hypertonic sweat secretions (Okuhira et al, 2015; Mishra et al, 2005), which may cause increased water diffusion into the skin (Seitz et al, 2008) leading to rapid skin wrinkling. However, this cannot explain the anatomical variance in the condition or unilaterality exhibited by some patients.

Wrinkling of the palms and soles is a natural phenomenon in humans when immersed in water for around 11 minutes or more; however, for those with AQK, this process occurs much more rapidly. Previous research has shown that wrinkling occurs only in patients with an intact sympathetic nervous system (Bull and Henry, 1977). Patients who are post-sympathectomy or with autonomic neuropathy do not exhibit water-induced wrinkling, strongly suggesting that sympathetic nerve activity is a key element of the pathology. The palms and soles have a higher density of sweat duct openings and sympathetic nerve terminals than other areas. It has been postulated that AQK represents an exaggerated sympathetic vasoconstriction of the skin. Immersion of the palms and soles leads to the rapid ingress of water into the numerous sweat ducts, altering the electrolyte balance and triggering a rapid vasoconstriction mediated by the sympathetic nervous system. Reduction in blood flow, in part, accounts for the skin whitening observed during immersion. Patients with CF and specific drug therapies may have altered electrolyte constituency in their sweat, potentiating this exaggerated, rapid sympathetic response. In addition, intense activity of the sympathetic nervous system could lead to the reported symptoms of itch and pain experienced by some patients (Wilder-Smith, 2013).

Treatment of the condition relies on avoidance of the trigger factors, particularly avoidance of water immersion. The use of topical antiperspirants for both patients was found to be of limited benefit. Aluminium salts contained in antiperspirants work by acid-base chemistry, precipitating in sweat ducts, creating temporary plugs. Consequently, sweating is restricted, and ingress of water is limited, reducing the symptoms of the condition. Potassium permanganate foot soaks can be undertaken by patients at home to dry the skin. Recommended guidelines (British Association of Dermatologists, 2015) suggest using four litres of warm water to which a tablet of potassium permanganate is added to make the water light pink. Vaseline is normally applied to the nails to prevent the solution staining the nails dark brown. The feet are then soaked for 10 to 15 minutes before being dried.

The use of iontophoresis for one of our patients was successful, as reported in a previous case (Errichetti and Piccirillo, 2015). Iontophoresis is a technique whereby the soles are placed into a tray containing tap water, and a small electric current of around 25mA is passed across the tray for around 15 minutes, three times a week. This technique proved effective for patient A, lasting a few months. Other suggested therapies include antihistamines, topical salicylic acid preparations, topical steroids and botulinum toxin injections (Nazik et al, 2016; Houle et al, 2010). However, evidence on effective management is lacking at present.

‘Predominantly, the condition presents symmetrically, typically on the palms and to a lesser extent on the soles of the feet around puberty’

Key message

The authors present two cases of bilateral AQK, unusually exclusive to the soles of the feet (one unilateral and one bilateral case), occurring in two male patients in otherwise good health. Minimisation of exposure to water, and treatment with antiperspirants and potassium permanganate, offered limited relief of symptoms; however, referral for iontophoresis was sought. Further research is required to offer more effective treatments for patients with AQK.

References are available to view online:
membersarea.cop.org.uk/the-podiatrist