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Invited Review

What has changed in canine pyoderma? A narrative review

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ABSTRACT

Canine pyoderma is a common presentation in small animal practice and frequently leads to prescription of systemic antimicrobial agents. A good foundation of knowledge on pyoderma was established during the 1970s and 1980s, when treatment of infection provided relatively few challenges. However, the ability to treat canine pyoderma effectively is now limited substantially by the emergence of multidrug-resistant, methicillin-resistant staphylococci (MRS) and, in some countries, by restrictions on antimicrobial prescribing for pets. The threat from rising antimicrobial resistance and the zoonotic potential of MRS add a new dimension of public health implications to the management of canine pyoderma and necessitate a revisit and the search for new best management strategies. This narrative review focusses on the impact of MRS on how canine pyoderma is managed and how traditional treatment recommendations need to be updated in the interest of good antimicrobial stewardship. Background information on clinical characteristics, pathogens, and appropriate clinical and microbiological diagnostic techniques, are reviewed in so far as they can support early identification of multidrug-resistant pathogens. The potential of new approaches for the control and treatment of bacterial skin infections is examined and the role of owner education and hygiene is highlighted. Dogs with pyoderma offer opportunities for good antimicrobial stewardship by making use of the unique accessibility of the skin through cytology, bacterial culture and topical therapy. In order to achieve long term success and to limit the spread of multidrug resistance, there is a need to focus on identification and correction of underlying diseases that trigger pyoderma in order to avoid repeated treatment.

Introduction

Although reliable prevalence data for canine pyoderma are lacking, bacterial skin infections were the second most frequent cause for presentation to first opinion veterinary practices in a United Kingdom (UK) survey on canine skin problems (Hill et al., 2006). Although rarely life threatening, pyoderma contributes substantially to canine morbidity through associated pruritus or pain, and potentially widespread severe inflammatory changes. Since pyoderma is always secondary to underlying disease, recurrence is likely unless such disease is corrected, requiring repeated therapy, and causing frustration and continuing expense.

Pyoderma is one of the main presentations leading to antimicrobial prescription in small animal practice (Hughes et al., 2012). A recent UK first opinion practice survey showed that 92% of 683 dogs with pyoderma, either suspected or confirmed, received systemic antibacterial therapy (Summers et al., 2014). With the continuing emergence of methicillin-resistant staphylococci, mainly *Staphylococcus aureus* (MRSA) and *Staphylococcus pseudintermedius* (MRSP), it is necessary to reduce antimicrobial, which is a principal driver of multidrug resistance; pyoderma provides excellent opportunities for good antimicrobial stewardship.

In this narrative review, we focus on how the emergence of MRSP, MRSA and other multidrug-resistant zoonotic pathogens has changed our approach to the management of canine pyoderma and how traditional treatment recommendations need to be adapted to deal with this increasing threat to antimicrobial effectiveness and to public health.

Foundation knowledge and clinical disease

Aetiology and pathogenesis

Since publication of the first comprehensive veterinary dermatology text books in the 1960s (Muller and Kirk, 1969), pyoderma has featured consistently as one of the major diseases affecting canine skin. It has been suggested that this is partly a consequence of the comparatively thin and compact canine stratum corneum, of the paucity of intracellular emulsion in the

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canine epidermis and of the lack of a sebum plug in the canine hair follicle (Lloyd and Garthwaite, 1982; Mason and Lloyd, 1993).

The critical question as to why pyoderma, particularly superficial pyoderma, develops and frequently recurs, is still understood incompletely. The major role of primary underlying disease in its aetiology is supported by the observation that the predominant staphylococcal pathogens are colonisers of the skin of healthy dogs and that most staphylococcal skin infections involve 'endogenous' strains, i.e. isolates genetically identical to those of the dog's healthy cutaneous and mucosal microflora (von Eiff et al., 2001; Pinchbeck et al., 2006, 2007).

Common underlying triggers, such as ectoparasite infestations, allergic skin diseases and endocrinopathies, have long been associated with pyoderma, with allergic disease being considered likely to be the main driver for recurrent forms of pyoderma (Mason and Lloyd, 1989; Colombo et al., 2007; Bloom, 2014). More specific concepts of quorum sensing (regulation of bacterial gene expression in response to fluctuations in population density), of a minimum infective dose and, most recently, findings from microbiome studies showing significant changes in diversity and composition during atopic dermatitis, have provided new insights as to why infection with opportunistic bacteria may develop in skin (Lloyd, 2014; Pierezan et al., 2016; Rodrigues Hoffmann, 2017).

Immunological defects in innate and adaptive immunity have been identified in deep pyoderma of German shepherd dogs presenting with widespread, highly inflammatory infections during the 1980s and 1990s (Wisselink et al., 1988; Chabanne et al., 1995; Shearer and Day, 1997), but could not be linked conclusively to the breed or the occurrence of pyoderma (Rosser, 2006). Fortunately, this devastating disease now seems to be rare, possibly following targeted breeding.

The gaps in our understanding remain frustrating but it is important to remember that, when underlying causes are not identified, use of the term 'idiopathic pyoderma' does not

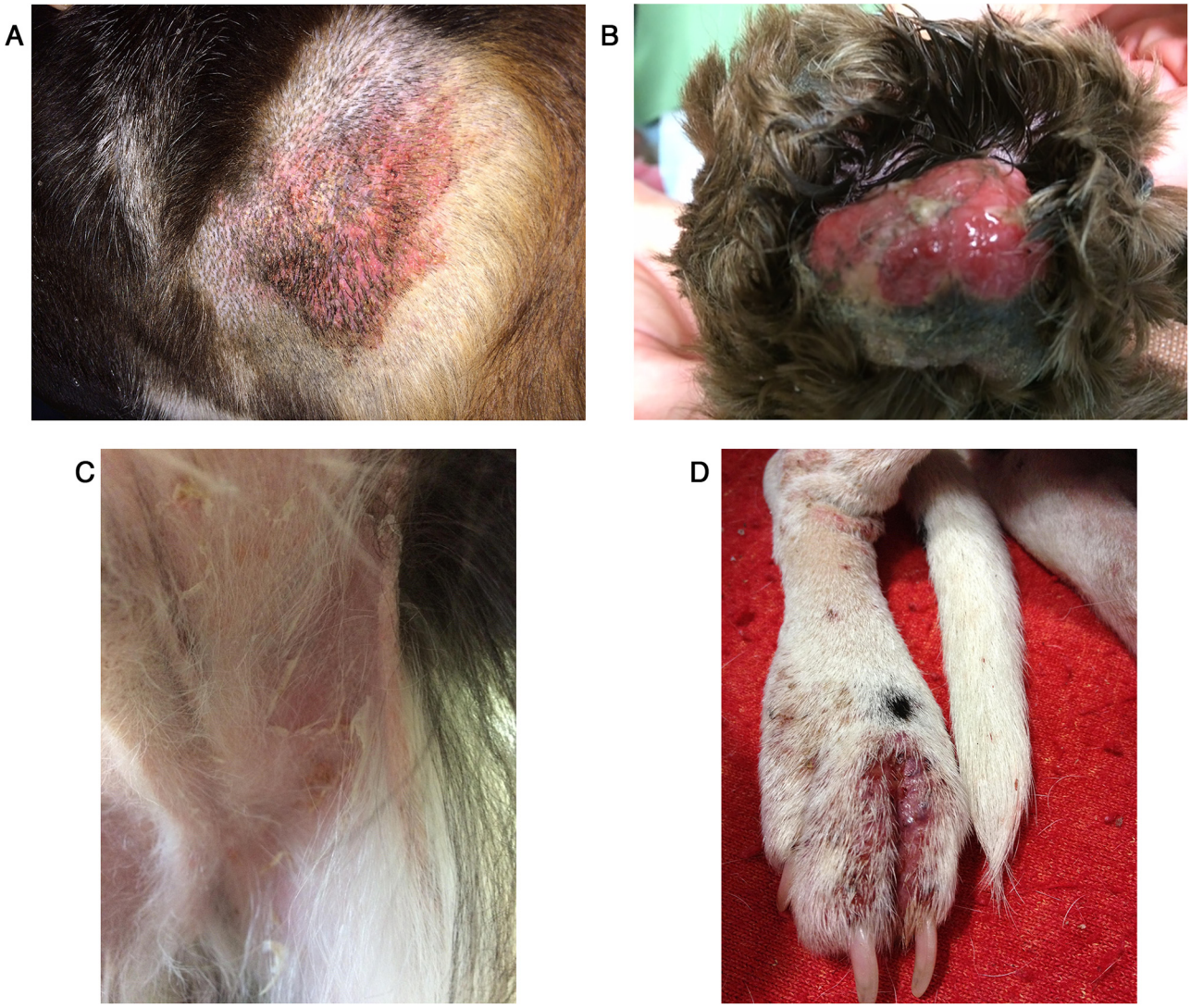

Fig. 1. Examples of recurrent or chronic (>3 months) pyoderma involving multidrug-resistant bacteria. All cases had received repeated courses of systemic antimicrobial agents with initial improvement. Pyoderma resolved when underlying triggering causes were diagnosed and treated in combination with antibacterial therapy. (A) Acute moist dermatitis with methicillin-resistant *Staphylococcus pseudintermedius* (MRSP) on the neck of a young atopic Saint Bernard. (B) Purulent *Klebsiella* spp. infection complicating erosive pad lesions in a sterile granulomatous disease. Both dogs were treated and remained in remission with topical antibacterial and systemic anti-inflammatory treatment. (C) Recurrent superficial pyoderma with expanding epidermal collarettes and focal crusts due to methicillin-resistant *Staphylococcus aureus* (MRSA) in a dog with early hyperadrenocorticism; infection resolved with topical antibacterial washes alone when the endocrinopathy was treated. (D) Widespread deep pyoderma involving *Pseudomonas aeruginosa* in a young Dalmatian dog with juvenile-onset demodicosis; there was no evidence of pyoderma on cytology after 3 weeks of systemic antibacterial and acaricidal therapy.