Title page

Encapsulated loculated abscess in older SPF swine: a case report and discussion

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Abstract

- **Background:**
  Abscesses are a common problem in humans, and the diagnosis and treatment of the condition is established. It is also seen occasionally pigs, but this is poorly documented in the literature. Treatment is often observational, with culling of the affected animal as necessary—inadequate treatment methods are often propagated in non-clinical farming resources. The aim of this report is to describe a simple, modern, effective approach to diagnosis and treatment of abscesses in pigs which is based on human medical practice, and to underscore the importance of this simple intervention in both laboratory and agricultural settings.
- **Case presentation:**
  The following report describes an encapsulated and loculated abscess in an SPF laboratory pig, presenting at an injection site two months after legally mandated vaccination with CSF vaccine. Despite SPF laboratory conditions, the abscess progressed. Clinical ultrasonic diagnosis revealed an encapsulated and loculated abscess. Incision and drainage was performed, with antibiotic lavage and post-procedure prophylaxis. The animal recovered uneventfully.
- **Conclusions:**
  The clinical presentation and presence of atypical gram-negative rods in the abscess pus establishes this abscess as a likely injection site infection, likely from fecal matter contamination. This occurred despite standard clinical precautions in an SPF-grade facility. One exacerbating factor may be the absence of antibiotic supplementation in our experimental feed mixture. Injection site abscesses are of increasing relevance as pigs and other farm animals receive increasing vaccinations, and minipigs in particular are increasingly kept past their prime meat age at 6 months for laboratory research into aging and chronic conditions, and as companion animals. Although abscesses are easily treatable, they

are usually exquisitely painful and may lead to systemic spread and death. Therefore, for humanitarian reasons and for reasons of increased sustainability in livestock farming and for good laboratory experimental practice, conditions such as abscess must be treated rapidly and appropriately as described in this case report.

Keywords

Abscess, pig, sus scrofa, ultrasound, specific pathogen free, incision, drainage, lavage, antibiotic

Background

Abscesses are a common problem in humans, and the diagnosis and treatment of the condition is established. For larger purulent encapsulated abscesses over 2 cm, antibiotic therapy is recommended, even in the absence of signs of systemic infection such as fever or other risk factors such as immune compromise or rapid progression[1]. Treatment in human clinical practice is simple and usually completely successful, and prevents the risk of systemic spread and potential demise. In human clinical practice, essentially all drainable discrete abscesses are incised and drained, with empiric antibiotic therapy chosen for more severe cases based on clinical criteria [1].

Abscesses are also seen occasionally pigs, especially associated with fighting and biting, but this is only sparsely documented in the modern academic literature [2]. Treatment is often observational, with culling of the affected animal as necessary—inadequate treatment methods are often propagated in non-clinical farming resources [3]. The overarching aim of this report is to describe a simple, modern, and effective approach to diagnosis and treatment of abscesses in pigs, and to underscore the importance of this simple intervention in both laboratory and agricultural settings.

Case presentation

A 2.6-year-old, 34 kg postpartum micro-minipig (*Sus scrofa domesticus*, from Fuji Micra Inc.) was found to have developed a growth on the left nuchal surface. The growth was discovered incidentally during normal husbandry. Housing was isolated (due to pregnancy) within a climate-controlled specific-pathogen free (SPF) experimental pig facility, with controlled exclusive entry through two shower/scrubbing chambers and an additional hypochlorous acid mist chamber. The individual had received a subcutaneous injection of conventional swine flu vaccine in the

approximate left nuchal area, just 2 months earlier, as mandated by the local government. The animal was pregnant at the time of injection. Pregnancy was complicated by anhedonia and reduced appetite for a week after vaccination, but labor and birth itself was uneventful.

A) Clinical examination and diagnosis

Upon examination, the animal was clinically alert, in no acute distress, interacting normally with its stall-mates and eating and drinking appropriately. Locally, a 5 cm partially erythematous tumor was evident at the mid-lateral point of the left nuchal aspect (Fig 1A). Inspection revealed depilation of the area, with no spontaneous drainage, hemorrhage, or exudate. Upon approach, the animal showed no signs of avoidance; however, upon palpation, the lesion was found to be exquisitely tender. The lesion was warm and fluctuant, with a broad base. The general status of the animal was judged to be stable, so it was left within the animal facility for observation.

After a slowly progressive course over one week of close observation, radiological diagnosis was performed with a clinical ultrasound (US) machine (Apelio V, Canon Medical Systems, Japan). Due to exquisite tenderness of the area, this was done under light mask anesthesia/sedation with 2.5% isoflurane and 40 µg/kg medetomidine IM, after receiving consent for probable incision and drainage. Ultrasound revealed an encapsulated, loculated abscess within the dermis, with no blood flow and no evident surrounding cellulitis (Fig. 1B). Solid lesions such as lipoma were excluded (Fig. 3). Aspiration was unsuccessful, as could be expected in a loculated abscess (Fig. 2A)

B) Treatment and outcome

Immediately upon definitive diagnosis with ultrasound, incision and drainage was performed as per standard human medical care. The

depilated local area of the abscess surface was cleaned and disinfected with iodine and then 70% ethanol. A 2-cm incision was made, and a total of approximately 40 ml of bloody pus was expelled (Fig. 2B). Most of the pus was expelled spontaneously in a lumpy manner, without intervention, demonstrating the encapsulated and loculated nature of the lesion. After manual expression and light curettage of the remaining pocket, extensive lavage was conducted at high pressure through a large gauge syringe needle inserted into the cavity through the surgical incision, first with lactated Ringer's solution and then with concentrated Ampicillin solution (200 mg/ml). The wound was closed with absorbable polygalactin suture in approx. 1.5 mm intervals with 12 sutures. Neither cyanoacrylate adhesive nor watertight bandages were applied, in order to allow acute drainage. Acute clotting and careful suturing facilitated wound healing and prevented dehiscence. Finally, one intramuscular dose of ampicillin (10mg/kg) was given prophylactically against systemic bacterial spread due to the procedure; see discussion below.

The animal recovered immediately from mask anesthesia with no acute signs of distress and was observed for 30 min prior to return into holding pen and clinical personnel exiting the SPF facility. Upon follow up, the animal demonstrated no further tenderness the following day, and sutures dissolved without event by 2 weeks, during which time the animal had no sequelae. After one month, no sign of the lesion was evident (Fig. 2D)

Gram staining of the purulent material demonstrated white blood cells with gram negative rods and no gram positive cocci (Fig. 2C), supporting a presumptive diagnosis of injection site simple loculated abscess, likely due to contaminating fecal matter.

Discussion and Conclusions

Abscesses are historically known to be an occasional problem in conventional pig farming, most commonly secondary to fighting or tail

biting among the herd. The reported case number has apparently decreased with the advent of antibiotic feed supplements and modern methods of herd control. However, the current move towards elimination of antibiotic feed supplements and the implementation of humane housing standards (such as the phasing out of docking), may lead to re-surfacing of abscesses as an important condition affecting productivity and sustainability. The exquisite tenderness caused by the condition and potential to become systemic lead to the necessity to treat such conditions, both in terms of humane pig farming and in the context of well-controlled preclinical research.

Despite this clinical relevance, the condition and its modern treatments are only sparsely documented in the modern veterinary literature, including in textbooks. Indeed, superficial abscesses in farmed pigs often go untreated, with observation and culling if the condition progresses. Treatments with limited efficacy, such as aspiration (Fig. 2A), are also promoted. When treated, incision and spontaneous drainage has been promoted, without irrigation or lavage or closure. There is no consensus on the clinical use of antibiotic therapy.

We document a simplified approach to diagnosis and treatment of abscesses based on modern human clinical practice (Fig. 3)..

The first element is radiological or clinical diagnosis to differentiate between encapsulated and non-encapsulated lesions. Non-encapsulated non-purulent lesions, which are indurated to the touch and not fluctuant, are not susceptible to treatment with incision and drainage, and systemic antibiotic therapy should be considered. An encapsulated or fluctuant lesion that is large enough to be noticed during the process of pig housing is most certainly a prime candidate for incision and drainage. Whether to use short-term systemic antibiotic prophylaxis for the procedure is dependent upon the risk of septic seeding: in humans, such

prophylaxis is conducted in the immunocompromised and in individuals with implanted foreign material such as cardiac valve transplants.

The diagnostic and therapeutic procedure for purulent abscess described here can be completed within 15 min by one operator in the field. The speed of the procedure can be further improved by using rapid non-suture closures such as surgical staples or adhesives. Care must be taken to close tightly enough to prevent reinfection during the healing process, but to leave leeway for postoperative seepage, as accumulation of such seepage in the evacuated pocket is a risk factor for reinfection and recurrence. The cost of the procedure can be lessened by use of a low-cost portable ultrasound, or by making a pure clinical diagnosis with observation and palpation sans imaging (Fig. 3).

In the case presented, the exquisitely tender lesion resolved immediately with the procedure, and our individual showed no signs of tenderness the following day, with no further sequalae (Fig. 2). The course was favorable and lead to complete resolution with no further interventions, as is generally the case in human medical practice. This is quite conducive to porcine welfare and health.

Our case also raises three related points of interest. First, our case highlights the importance of basic clinical precautions during vaccination and other injections in farm animals and experimental animals. Such precautions are quite simple but have been implemented only sporadically especially in farming. Even with implementation of such measures and even within an SPF facility, such as in our case, abscess formation can occur. Pregnant sows, such as this individual at the time of infection, may be more susceptible due to altered immune status, and the guidelines for pig immunization during pregnancy should be revisited with this in mind. With the move toward elimination of antibiotic supplementation in feed[4] and the increasing number of vaccinations necessary in livestock farming, it is particularly important to prevent

iatrogenic infections, both for animal welfare and for farming productivity. Use of non-antibiotic feed in our case may have also contributed to raise the risk of abscess formation. Of contrary note, however, data suggests that the absolute rate of abscess formation in conventional pig farming may not be that higher in non-antibiotic fed pigs[5].

Second, our case is notable in that the presumptive pathogens in this SPF pig were likely enteric in nature, as they were gram-negative rods (Fig 2C), and not the gram-positive cocci reported to be predominant in most spontaneous case series [6]. This further underscores the need for strict infection control measures and appropriate clinical care even an SPF facility, where infectious risks are mitigated. Showering is quite enjoyable to most well-kept laboratory pigs, in our experience, and should be encouraged prior to procedures such as vaccination to minimize fecal contamination.

Third, pigs are increasingly kept for longer periods of time, especially in the context of laboratory animal medicine, and as pigs age, they will become more susceptible to such simple medical conditions. Therefore, the prevention and appropriate treatment of conditions such as abscess is of particular interest in translational research, both regarding naturalistic models of human abscesses [7] and in the use of pigs as models of aging and lifespan.

List of Abbreviations

- SPF: specific pathogen free
- US: ultrasound

Declarations

- Ethics approval and consent to participate
  Written approval and consent for housing and veterinary care were obtained from the Tokushima University, via the Animal Care and Use Committee.

- Consent for publication
  Written consent for use of this animal for scientific publication was obtained from the Tokushima University, via the Animal Care and Use Committee.

- Availability of data and materials:
  The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

- Competing interests:
  Not applicable

- Funding
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- Authors' contributions
  KT conceived and oversaw this study, and oversaw clinical testing, histology, interpretation, and treatment. TO identified the case and

participated in assessment and husbandry and care, as well as assisting in manuscript preparation. All authors read and approved the final manuscript.

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A

B

Fig. 1 A. Preoperative view of a left nuchal injection site tumor. B. Ultrasound revealed a well encapsulated loculated dermal abscess approximately 3cm deep and 5 cm wide, with no blood flow.

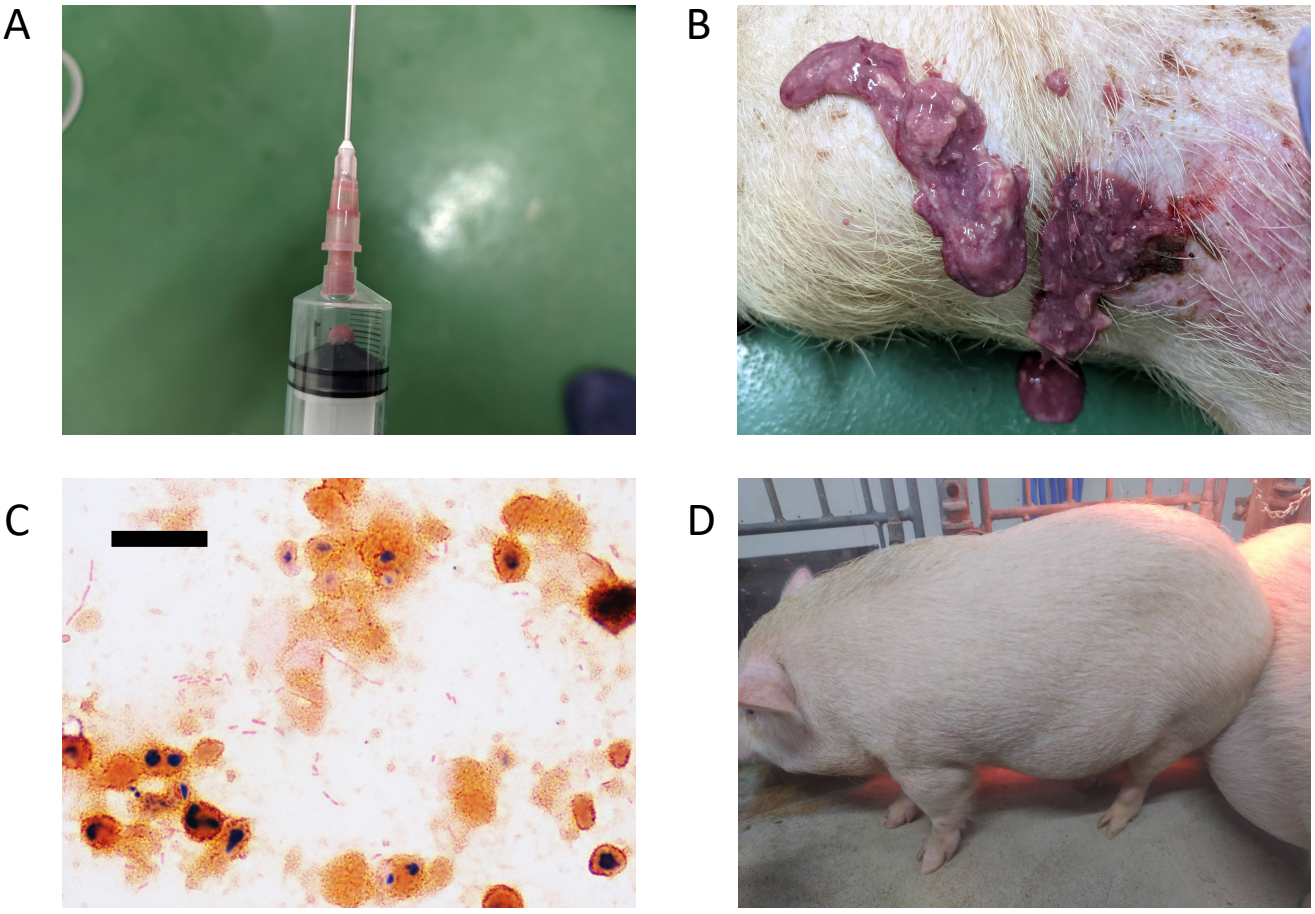

Fig. 2 A. Aspiration was unsuccessful as predicted from loculation seen in ultrasound (Fig. 1B). B. A 2 cm incision led to immediate spontaneous drainage of approximately 40ml of purulent bloody pus. C. Gram stain revealed white blood cells and abundant gram-negative rods. Scale bar 200µm. D. The animal recovered immediately with an uneventful course, and 2 months after drainage and lavage, the animal showed no signs of the previous lesion.

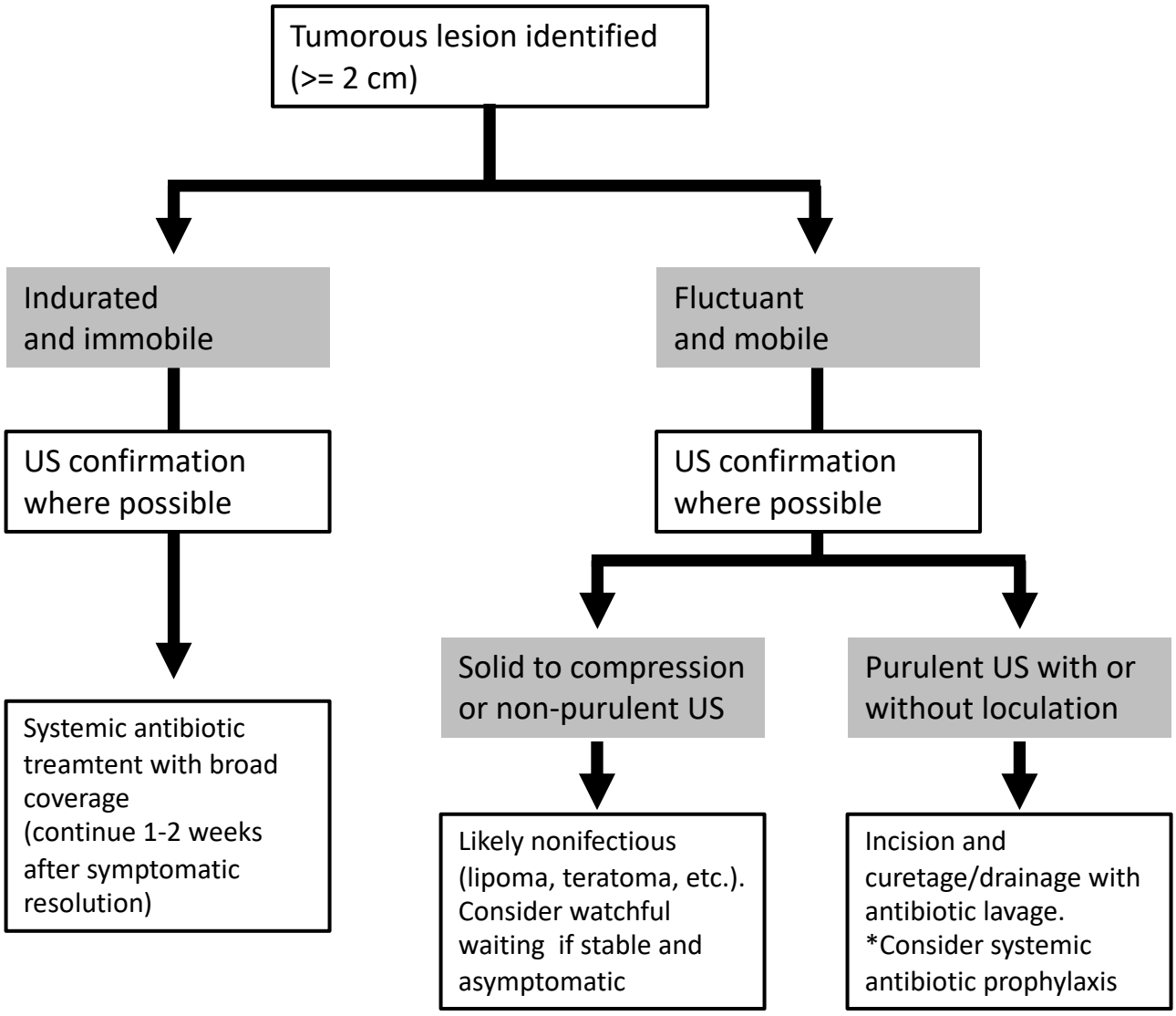

Fig. 3 Flowchart for simplified treatment of abscess and related tumorous lesions in pigs.