Maggots for the management of purpura fulminans in a paediatric patient

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Purpura fulminans (PF) is a haemorrhagic condition that can occur with sepsis such as meningococcal septicaemia (Nolan and Sinclair, 2001). This can result in soft tissue and skin necrosis and can be further complicated by the development of compartment syndrome. This disabling condition often requires surgical intervention and limb amputation (Betrosian et al, 2006). The case report presented here describes the use of maggot therapy to safely and effectively debride extensive areas of necrosis while decolonising the wound.

It is estimated that approximately 3,000 people are affected by meningococcal meningitis and meningococcal septicaemia in the UK each year (Meningitis UK, 2009).

Meningococcal septicaemia is associated with higher mortality and is most commonly caused by the serogroup B bacteria *Nisseria meningitidis* in the UK. Infants of pre-school age, peaking around two years of age, are more at risk of developing meningococcal disease as they lack immunity. Up to 50% of those who develop meningococcal septicaemia will die if there is a delay in receiving medical care (Meningitis UK, 2009).

Infectious purpura fulminans

The meningococcal bacteria enter the blood stream via the nasopharynx where an endotoxin is released triggering an inflammatory response which causes capillary leakage and activates the coagulation system (Hunt, 2001).

Infectious PF is considered a rare, potentially disabling and life-threatening disorder which can occur secondary to septicaemia (Darmstadt, 1998; Warner et al, 2003; Betrosian et al, 2006). PF is characterised by the acute onset of disseminated intravascular coagulation and dermal vascular thrombosis. This causes rapid dermal haemorrhage, resulting in irreversible skin and soft tissue necrosis which can potentially lead to the amputation of digits and/or limbs (Darmstadt, 1998; Betrosian et al, 2006; Dippenaar et al, 2006). A number of management strategies for PF are described in the literature, including; anticoagulation, vasodilation, activated protein C replacement, plasmapheresis, continual renal replacement therapy, corticosteroids, fasciotomies, hyperbaric oxygen and medicinal leeches, all with variable results (Darmstadt, 1998; Nolan and Sinclair, 2001; Warner et al, 2003; Dippenaar et al, 2006).

Compartment syndrome is caused by the increased pressure in the fascial space due to either an increase in compartment contents or a reduction in the compartment size, which causes interruption to the circulation of the affected area (Bradley et al, 2009). As a result of the haemorrhagic process during the acute phase of PF and the subsequent increase in compartment contents, compartment syndrome is likely to occur. Delayed diagnosis and management can result in limb ischaemia, further tissue necrosis, limb amputation and even death (Johnson and Chalkiadis, 2009). The predominant sign of the development of compartment syndrome is pain, however, this is not always easy to assess in paediatric patients, especially those of a very young age (Bradley et al, 2009). Other signs and symptoms include oedema, pallor, parasthesia, paralysis and pulselessness, however, these are considered to be late signs and the probability of permanent functional loss is high when these are present (Bradley et al, 2009). Prompt surgical decompression (fasciotomy) of the affected limb(s) is necessary to restore circulation, avoid amputation and preserve functionality (Bradley et al, 2009; Johnson and Chalkiadis, 2009).

Maggot therapy

Maggot therapy, also known as larval therapy, has been used in wound management for centuries and became popular among surgeons post World War I after Baer (1931) reported the benefits of them in the maggot-infested wounds of soldiers. After the introduction of antibiotics their use declined, only being considered as a last resort in the management of chronic wounds. However, due to the rise of antibiotic-resistant strains of bacteria there has been a recent revival in larval therapy (Steenvoorde et al, 2007). The trend is changing and larval therapy is being seen as a first-line management option due to an increase in available evidence supporting its clinical and cost benefits (Wayman et al, 2000; Lodge et al, 2006; Thomas, 2006).

In the UK maggots are supplied by Zoobiotic under the brand name LarvE™. These are the medicinal maggots of the greenbottle fly *Lucilia sericata*. They are available in two forms: 'free-range', which are pots containing maggots which are applied to the wound and allowed to roam freely while retained under a net and gauze dressing; and the LarvE Biofoam™ dressing, which is a fine net pouch containing medicinal maggots and lots of small foam chips which serve to provide an optimum environment for the maggots and absorb some of the wound exudate (Lodge et al, 2006).

Maggots feed by ingesting micro-particles of food by scraping or tearing at devitalised tissue with their mouth hooks. This action allows the digestive proteolytic enzymes that they secrete or excrete to penetrate and semi-liquefy the tissue which they then ingest (Thomas et al, 2002). It is important to note that this scraping and tearing action is undetectable by the patient.

The secretions of these maggots are able to kill or prevent growth of a wide range of bacteria, including methicillin

resistant *Staphylococcus aureus* (MRSA) (Thomas et al, 1999). Thomas et al (1999) discovered that the secretions of the maggots inhibited growth of Gram positive organisms *in vitro* such as *S. aureus* and Streptococcus group A and B but that they promoted the growth of the Gram negative organisms *Escherichia coli* and *Proteus* species. The eradication of pseudomonas and MRSA in the wound occurs when the bacteria are ingested by the maggot and destroyed in the gut (Thomas and Jones, 2000).

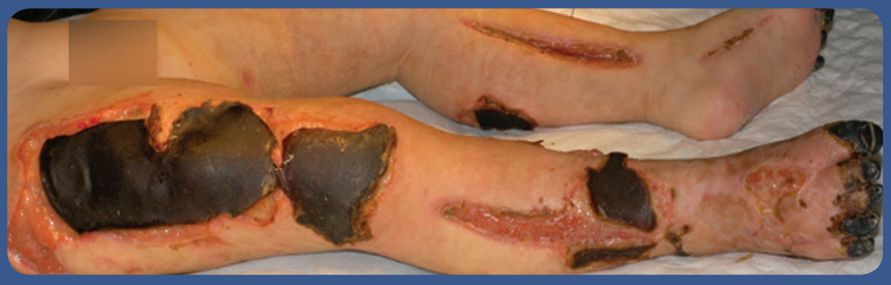


Figure 1.

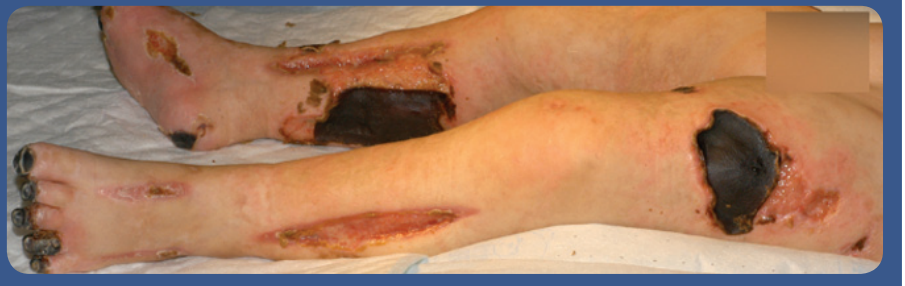


Figure 2.

Case report

A 20-month-old girl with no significant past medical history was admitted to hospital with suspected meningococcal septicaemia, this was later confirmed by the growth of *Nisseria meningitidis* from a blood culture. After a 12-hour history of a non-specific illness she presented to the paediatric emergency department. At this time she was generally unwell with a generalised purpuric petechial non-blanching rash; she was initially alert and crying. Her condition rapidly deteriorated requiring intubation, fluid resuscitation and inotropic support. She was then transferred to the paediatric intensive care unit (PICU), where she required three days of haemofiltration for which she was commenced on an anticoagulant infusion.

On the first day of her admission she was reviewed by a plastic surgeon for assessment of her peripheral circulation and the muscle compartments of her limbs. At this stage she was assessed as having large patches of skin necrosis due to PF with subcutaneous oedema only. Two days after her admission she developed compartment syndrome and required fasciotomies of her lower legs, feet and right hand. All underlying muscle was found to be viable at this time.

Three weeks after admission she was well enough to leave the PICU and care was continued on a general surgical ward. A computed tomography (CT) scan of her brain was normal and she was left with no neurological or sensory impairment.

The resultant damage from the PF included necrosis of all toes, distal digits of the right hand and the thumb and forefinger of the left hand. She also had very large patches of soft tissue and skin necrosis to both legs, buttocks and hips (*Figures 1* and *2*). The areas to the hips and buttocks were managed with hydrocolloid dressings and hydrogel sheet dressings containing medical honey and by the fourth week of treatment most of the necrotic tissue was removed and the wounds were progressing towards healing. The necrosis to both legs was managed conservatively with non-adherent dressings, as is usually the case with these wounds in paediatric patients. By the fourth week of admission these necrotic patches started to separate at the edges and were critically colonised with *S. aureus* and anaerobes. Clinically, she displayed no signs of systemic infection apart from sporadic low grade pyrexia, below 38°C, thought to be due to the inflammatory response from the wounds. At this time the wounds to her legs were dressed with a non-adherent contact layer containing silver sulfadiazine.

On the fourth week of her admission, after further review by the plastic surgeon and the paediatric tissue viability specialist, maggot therapy was discussed with the child's parents and the decision was made to apply maggots to both her legs and feet, excluding the digits. It was hoped that this therapy would facilitate rapid debridement of the necrotic tissue and de-colonisation of the wounds. Due to the extent of tissue damage, it was thought that surgical debridement may cause significant haemorrhage and possibly increase the risk of infection. The other alternative would have been to facilitate debridement by autolysis through the use of appropriate wound dressings, as had been used on her buttocks and hips. This would have taken significantly longer and increased the risk of critical colonisation developing into more serious localised and potential systemic infection.

After discussion with a nurse advisor from Zoobiotic and use of their on-line calculator, it was decided that five pots

of maggots would be required for the initial application. The aim was to achieve maximum debridement and reduce the bacterial burden on the wound through the use of a larger amount of maggots over a shorter period of time. The maggots were applied under general anaesthetic (GA) and the larger patches of necrosis were scored with a scalpel to allow the maggots to access as much of these areas as possible (*Figure 3*). Three pots were applied to her right leg and two to her left. *Figures 4* and *5* illustrate how the net dressing was secured before the outer bandage was applied and the size of the maggots before application. They were removed under GA after 72 hours (*Figure 6*) to reveal that over 50% of the necrotic tissue had been removed (*Figures 7* and *8*). At this time three more pots were applied, two to the right leg and one to the left. After 48 hours these were removed without GA, as the child had become increasingly restless and a small number of maggots had escaped from the dressing. There was total debridement of all wounds except a small patch on the posterior right calf. The patella of her right knee was now exposed (*Figure 9*). Swabs of all the wounds were taken after both applications and after the second application no *S. aureus* or anaerobes were isolated.

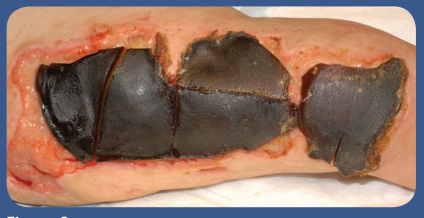
It was decided that her wounds should be left to heal by secondary intention and the digits were left to autoamputate. By week 10 of her admission the smaller wounds had healed and the larger wounds had significantly reduced in size and depth (*Figures 10* and *11*). A variety of wound care products were used during this time. Unfortunately, she developed septic arthritis of her right knee due to bone necrosis from the PF. This required the removal of her patella and the cavity was closed using a gastrocnemius muscle flap. Split skin grafts were applied to the remaining leg wounds at this time and a week later she was discharged home.

Discussion

Baer (1931) reported using maggots for the treatment of chronic osteomyelitis in children with consistently good results and, interestingly, the maggots were used until wound closure was achieved. This case report is the first reported instance of which the author is aware in which maggots have been used in children in recent times. The author has used them on two previous occasions in adolescents who were unable to undergo GA for surgical wound debridement for varying reasons, such as neutropoenia and parental refusal to consent to general anaesthetic, and in whom autolytic debridement had failed. On one of these occasions the maggots did not survive beyond 24 hours and are thought to have perished due to drowning in wound exudate. However, partial wound debridement was achieved in this short time. On the second occasion full debridement of the wound was achieved. These earlier personal experiences gave the author confidence to use maggots and also to apply them on such a large scale.

The other common obstacle, the so-called 'yuk' factor to the patient and their family, was easily overcome in this case as both parents readily accepted this treatment option as they were keen to take their daughter home and return to normal family life as soon as possible. They were also made aware that the maggots could be removed at any time if it became no longer acceptable to them or their child.

Pain has been previously documented with the use of maggot therapy (Trudgian, 2002). On this occasion the child did not appear to be in pain but, although not distressed, she became increasingly restless the longer the maggots were in place, culminating in a sleepless night on the third day of the first application. It was unclear whether the restlessness was due to itch or the movement of the maggots as they grew in size. Her legs also became 'jumpy' at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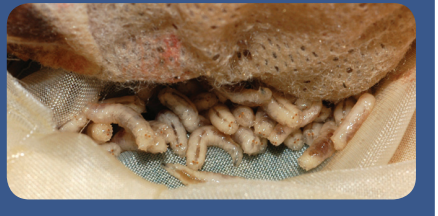
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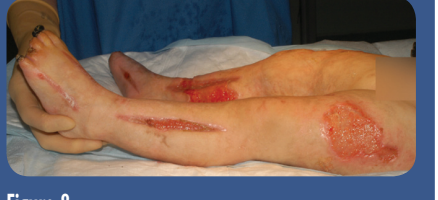
Figure 8.

this point and again this was attributed to the movement of the now larger maggots. For these reasons it was agreed that if she displayed any of these signs on the second application the maggots would be removed sooner than the recommended 72 hours, and this was done after 48 hours.

Perhaps the use of the Biofoam™ dressing may have reduced the irritation felt by the 'free range' maggots. These would only have been suitable for the second application once the larger patches of necrosis had reduced in size. Several bags would have been required and would have been better left in place for up to five days.

There are also the significant risks associated with repeated GA to be considered. However, a GA would also have been required for surgical debridement of the wound. Without the use of a GA it would have been extremely difficult to apply the free range maggots on such a large scale in a child of this age. Again, the use of the teabag style maggot dressing may have avoided the need for the second GA.

During the removal of the second application of maggots it was noted by the practitioner that despite the absence of necrotic tissue in this area, the maggots had congregated over the patella which at this time appeared viable. If the maggots had perhaps been left in situ for a longer period of time, the extent of the bone involvement may have been revealed leading to more timely surgical intervention.

Conclusion

Although not appropriate or acceptable for every patient and their family, maggot therapy is an additional wound management option that should be considered in paediatric patients. In this case report the desired aims were achieved in a short period of time. In an older child with more advanced verbal communication, the maggots may have been removed far earlier due to irritation than they were in this case. Maggot therapy will be considered for use in children in the future by this author and it is hoped that the documentation of this case report will encourage other practitioners to consider it as a wound management option for this patient group. WUK

Acknowledgements

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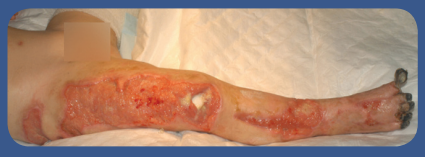

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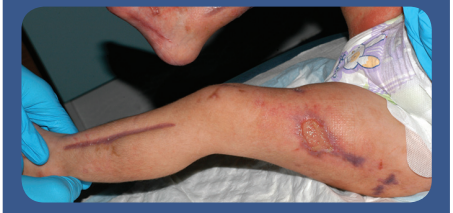

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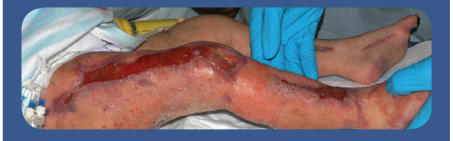

Figure 11.

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