

The mythos of laudable pus along with an explanation for its origin

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ABSTRACT

The presence of pus is one of the most easily recognizable signs of an infection. However, for several centuries suppuration, known as ‘laudable pus,’ was believed to be a sign of a healthy, healing wound. This historical misconception can be explained by the difference in the presentation of a necrotizing soft tissue infection versus other more common skin and soft tissue infections. Chronic wound infections, due to pyogenic bacteria, typically produce large amounts of thick, whitish-yellow pus. On the other hand, necrotizing soft tissue infections, despite their severe mortality and morbidity, are devoid of pus in the traditional sense. What the ancient medical observers recognized was the fact that pus is not characteristic of this subset of incredibly severe infections. This is an important distinction to remember when evaluating an infection, even today.

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Our modern-day attention to sterility in the operating room makes antiseptic technique seem second nature. However, for many centuries the idea that pus was necessary and beneficial for wound healing was considered dogma among surgeons [1]. Although the phrase ‘pus bonum et laudabile’ (good and laudable pus) was crafted by later physicians [2], it arose from observations that date back to ancient Greece. Hippocrates, commenting on wound healing, remarked that ‘if the pus is white, and not offensive, health will follow,’ but if it is ‘sanious¹ and muddy, death is to be looked for’ [3]. However, the Greek physician, surgeon, and philosopher Galen of Pergamon (129–199 AD) is typically the one who is blamed for the pervasiveness of the concept of ‘laudable pus’ in early Western medicine. This is an unfortunate misunderstanding, as Galen did not believe that pus was required for wound healing [4]. He actually advocated crude medical therapies designed to dry wounds and reduce the amount of suppuration [5]. The confusion probably arose from Galen’s advice on abscesses, a condition where he did think it was important to see pus since the lack of drainage could prove fatal [5].

It was not until the 13th century that the doctrine of laudable pus was substantially challenged. Theodorico Borgognoni, an Italian surgeon writing in 1267 AD, called for the use of measures to prevent the formation of pus in healing wounds [6]. The French surgeon Henri de Mondeville also questioned the idea of laudable pus in his 1312 work, *Cirurgia* [7]. However, the view that pus was a part of healthy wound-healing was so entrenched among the medical

community that these men’s views were largely discredited. A collection of accounts of treating wounds during the American Civil War recommends leaving wounds alone once gangrenous material has been removed and ‘laudable pus’ has appeared [8]. Only with the advent of Ignaz Semmelweis, Louis Pasteur, and Joseph Lister in the 19th century and their respective work on hygiene, germ theory, and antiseptic technique was the idea of encouraging pus in healing wounds put to rest [9]. Their work helped lead to the realization that pus was a sign of an infection instead of a sign of a healthy, healing wound. The term ‘laudable pus’ faded out of the medical literature in the early 20th century. Possibly the last use of the term in a major medical journal can be found in 1916, when the authors refer to ‘laudable pus’ that can be ignored because they believe it does not preclude wound healing [10].

Despite the misinterpretation of some of their writings, Hippocrates and Galen almost certainly recognized that the most desirable situation was a wound in which none of the classical signs of an infection was present. As recorded by Hippocrates, a ‘very favourable’ wound was one with ‘an absence of fever, hemorrhage, and inflammation, and no pain’ [3]. However, in an era before antibiotics, antiseptic methods, or even an understanding of what the true cause of suppuration was, it was almost inevitable that a wound would become infected. It is in this context, and only in this context, that the idea of laudable pus makes sense. In fact, the comments by Hippocrates on favorable signs in wound healing represent an early understanding of something that

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¹Consisting of a thin mixture of serum and pus with a slightly bloody tinge.

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is well appreciated today – the presentation and course of a wound infection depend on which bacteria are responsible for the infection.

The thick, white, odorless discharge that was traditionally described as laudable pus is the product of pyogenic bacterial infections. Often these are due to *Staphylococcus aureus*, although a number of other bacteria are also isolated from wounds [11–15]. While *S. aureus* and other pyogenic bacteria can cause highly purulent skin and soft tissue infections (SSTIs), the vast majority of these infections are superficial and unlikely to be fatal. Even with the recent epidemic of more virulent community-acquired methicillin-resistant *S. aureus* strains, healthy, immunocompetent individuals may not require antibiotic treatment for a superficial staphylococcal SSTI [16,17]. In fact, the principles of modern-day treatment for superficial surgical site infections and other simple SSTIs are not very changed from Hippocrates' era. As Hippocrates and Galen both noted, it is important to encourage drainage from an infected wound because an undrained abscess can lead to death [3,5]. An incision and drainage of pus followed by sterile wound-dressings are usually sufficient when there are no signs of systemic infection, and antibiotics are often unnecessary [18]. However, *S. aureus* can also cause serious, invasive infections, and over 15% of *S. aureus* bacteremia cases begin as SSTIs [19]. Therefore, in an SSTI complicated by signs of a systemic infection such as fever, tachycardia, tachypnea, or an abnormal white blood cell count, antibiotics represent an important part of treatment [18], and one that Hippocrates lacked.

The alternative to 'laudable pus' presented by Hippocrates most likely represents the necrotizing and gangrenous wound infections that are less commonly seen in the modern era. Although most of these infections are polymicrobial, many of them are associated with beta-hemolytic streptococci and clostridial bacterial species. Today these infections are referred to as necrotizing soft tissue infections (NSTIs), but they have gone by multiple names throughout history, including phagedena and hospital gangrene [20]. Despite being nonpurulent, these infections are associated with high mortality and morbidity, even with modern-day antibiotic treatment [21–23]. NSTIs, including necrotizing cellulitis, necrotizing fasciitis, necrotizing myositis, and myonecrosis, typically have an insidious presentation. A seemingly healthy individual can develop severe pain followed by a rapidly progressing necrosis that leads to septic shock and death, all within 24–72 hours of the initial onset of symptoms.

Between these two very different presentations and outcomes, it is understandable why ancient observers might have been less afraid of wounds that were dispelling a thick, creamy white pus. The question that remains, however, is whether the presence of 'laudable pus', i.e., a staphylococcal infection, offers some sort of mortality benefit. Historically, *S. aureus* was only isolated in

polymicrobial cases of necrotizing fasciitis, although it has been increasingly found in monomicrobial NSTIs [24]. Despite it often being found along with beta-hemolytic *Streptococcus*, one study found that the presence of *S. aureus* in an NSTI, whether monomicrobial or polymicrobial, was actually associated with a survival benefit [25]. Furthermore, monomicrobial cases of necrotizing fasciitis are associated with greater mortality than polymicrobial cases [22,26]. This is particularly true for NSTIs due to *Clostridium*. *Clostridium* species, including *C. perfringens*, are associated with very high mortality rates, particularly when they are the only organism cultured [22,27]. As most cases of necrotizing fasciitis due to beta-hemolytic *Streptococcus* or *Clostridium* occur rapidly after initiation of a wound, it is interesting to speculate on whether colonization of a wound by *Staphylococcus* species precludes the development of a more fulminant infection by another organism.

While the term 'laudable pus' is no longer used today, perhaps some of the observations wrapped up in the origin of that phrase still have merit. Included in the Infectious Disease Society of America's 2014 guidelines on managing SSTIs is a distinction between purulent and nonpurulent infections, with a nod to the fulminant nature of many nonpurulent SSTIs and the urgency with which they should be evaluated [18]. Perhaps the lasting lesson from the long history of 'laudable pus' is that the lack of pus should not be taken as a 'bonum et laudabile' sign.

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