Necrotizing Soft Tissue Infection Masquerading as Cutaneous Abscess Following Illicit Drug Injection

Troy E. Callahan, MD; William P. Schecter, MD; Jan K. Horn, MD

Objective: To assess factors that might predict serious necrotizing soft tissue infections following illicit drug injection.

Design: A retrospective review of a consecutive case series.

Setting: An urban municipal hospital.

Patients: Thirty patients presenting with cutaneous abscesses resulting from illicit drug injections during a 5-year period. All cases presented clinically with fluctuance, erythema, or induration but required extensive debridement at the time of incision and drainage.

Interventions: Operative treatment employed wide incision, routine subfascial examination, and aggressive debridement. Clinical management included broad-spectrum antibiotics, critical care support, and reconstructive procedures.

Main Outcome Measures: Mortality, extent of debridement, preoperative vital signs and laboratory values, Acute Physiology and Chronic Health Evaluation II (APACHE II) scores, bacteriologic and pathologic test results.

Results: Postoperatively, all patients were housed in the intensive care unit for 8.4 ± 14.5 days. Six patients died (20%). On arrival at the intensive care unit, systolic blood pressure was 80 mm Hg or less in 2 patients, 1 of whom died. White blood cell count on hospital admission was elevated in 27 of 30 patients (mean, 27.2 ± 15.3 × 10^9/L) and 2 patients were identified as having human immuno deficiency virus infection. All patients underwent initial surgery less than 24 hours after admission; following debridement, the average wound size was 276 ± 238 cm^2 (range, 15-783 cm^2). Five patients required extremity amputation, and all other survivors underwent reconstruction with skin grafts and/or myocutaneous flaps. All but 1 patient were reexamined in the operating room within 12 hours and underwent an average of 3.1 ± 1.6 operative procedures. Of those wound cultures obtained in the operating room, there was no pattern to the bacteriologic isolates. Seventeen patients had mixed isolates and 11 had single organisms. Pathologic findings in 20 patients included panniculitis (3 patients), necrotizing fasciitis (11 patients), myositis (6 patients), and osteomyelitis (1 patient). We failed to identify any clinical factor, including temperature, heart rate, systolic blood pressure, white blood cell count, base deficit, albumin level, PO2, or APACHE II score that could predict mortality or the requirement for extensive debridement.

Conclusions: Parenteral injections of illicit drugs can produce infections that present with signs of simple cutaneous abscess and yet unpredictably become extensive necrotizing soft tissue infections. Treatment requires a high index of suspicion along with an inquisitive operative approach to avoid missing these potentially serious infections.

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MATERIALS AND METHODS

All admissions to the surgical intensive care unit at San Francisco General Hospital, San Francisco, Calif, from January 1992 to August 1997 were reviewed and patients with the admitting diagnosis of NSTI were screened to include only those with a history of intravenous drug use (IVDU). Records were reviewed for various data including age, sex, race, history, predisposing factors, presenting symptoms and clinical signs, anatomic site, pathologic characteristics, laboratory results, operative intervention and number of debridements, need for amputation, bacteriologic results, and outcomes such as survival and length of stay. Appropriate data were used to calculate Acute Physiology and Chronic Health Evaluation II (APACHE II) scores on intensive care unit admission.

Necrotizing soft tissue infections were defined by the presence of necrosis in the subcutaneous tissue, fascia, muscle, or bone. Patients were treated with a standard approach of fluid resuscitation, broad-spectrum antibiotics, and wide incision with routine subfascial examination. It is our policy to reexamine the wounds in the operating room within 6 to 12 hours after the initial surgery for evidence of progression and further debridement. Reconstruction occurred following resolution of infections with some combination of closed amputation, skin grafting, or application of myocutaneous flaps.

Choice of antibiotics was determined by individual attending physicians without constraint of protocol. In all cases these consisted initially of some combination of penicillin, ampicillin, gentamicin, and metronidazole. Following culture results, antibiotic coverage was altered to reflect culture sensitivity. There was no consistent pattern of antibiotic coverage and all treatment was maintained for approximately 10 to 15 days.

Data were analyzed by univariate analysis using standard statistical software. Continuous data were compared by an unpaired Student t test and nominal data were compared by contingency analysis. All parameters are expressed as mean ± SD and P < .05 was considered significant.

RESULTS

Between January 1992 and July 1997, 3560 patients at San Francisco General Hospital underwent incision and drainage of a subcutaneous abscess that was a consequence of IVDU. Of this group, 30 intravenous or parenteral drug users were identified who required wide debridement for NSTI uncovered during the incision and drainage procedure. In all cases, patients admitted to parenteral injections of either heroin, cocaine, amphetamines, or some combination. The Figure displays the frequency of NSTI cases by year, demonstrating a dramatic increase in the incidence of such infections during the last 2 years. One cluster of 7 cases treated in 1996 was associated with “black tar” heroin. These patients presented with apparent extensive tissue necrosis that may have been exacerbated by the presence of a black adherent tarlike material that was routinely found infiltrating the tissues. The sexual distribution of the group was 18 men and 12 women with the mean age of 40.8 ± 8.0 years (range, 27-64 years).

RISK FACTORS

Two patients had known human immunodeficiency virus (HIV) disease, 6 stated they were HIV negative from testing within the past 6 months, and in the remaining 22 patients the HIV status was unknown. Twenty-four patients were smokers and 6 were nonsmokers. None of our patients suffered from diabetes mellitus or had any significant history of peripheral vascular disease. Of 19 patients who had serum albumin levels assessed, only 2 patients had a serum albumin level of 30 g/L or greater.

CLINICAL PRESENTATION

Patients presented with a wide variety of physical findings, as presented below.

<table>
<thead>
<tr>
<th>Physical Finding</th>
<th>No. (%) of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythema</td>
<td>23 (77)</td>
</tr>
<tr>
<td>Swelling</td>
<td>6 (20)</td>
</tr>
<tr>
<td>Induration</td>
<td>13 (43)</td>
</tr>
<tr>
<td>Fluctuance</td>
<td>6 (20)</td>
</tr>
<tr>
<td>Bullae</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Necrosis</td>
<td>3 (10)</td>
</tr>
<tr>
<td>Crepitance</td>
<td>1 (3)</td>
</tr>
</tbody>
</table>

Two of our patients presented with erythema alone. Two patients presented with induration and 2 presented with
skin necrosis as the only finding. One patient had crepitation present on examination. Comparison of survivors and nonsurvivors is displayed in Table 1. Two patients arrived in shock (systolic blood pressure ≤ 90 mm Hg) and both died. The mean systolic blood pressure was 118.6 ± 22.3 mm Hg, the mean heart rate was 107 ± 18.2/min, and the mean respiratory rate was 18.3 ± 4.9/min. All patients required ventilatory support following the procedure for initial debridement. The APACHE II scores calculated on intensive care unit admission ranged from 5 to 29 and did not correlate with survival.

BACTERIOLOGIC AND PATHOLOGIC RESULTS

Results of cultures and isolates are displayed in Table 2. Twenty patients had specimens submitted for pathologic evaluation. One of the 4 early deaths occurred from a single-organism infection (Clostridium perfringens). Of these, 17 patients displayed necrosis of the skin and 11 had necrotic fascia. An additional 6 patients had myonecrosis and 1 patient had osteomyelitis (Table 3).

SITE OF INFECTION

Fifteen patients had NSTI involving the upper extremity, 7 infections were limited to the lower extremity, and 3 presented in the buttock region. Five patients had involvement of multiple areas, both trunk and extremities. The size of the wounds following debridement varied considerably (range, 15-783 cm²). The extent of the wound area failed to correlate with the area of erythema, fluctuance, or induration. There were 4 patients who required upper-extremity amputation and 1 required lower-extremity amputation. Three of these 5 patients survived.

LABORATORY AND DIAGNOSTIC IMAGING TESTS

Most patients presented with at least 1 abnormal laboratory parameter. Four patients presented with white blood cell counts less than 11.0 × 10⁹/L and 18 had white blood cell counts greater than 20 × 10⁹/L. Ten patients presented with elevated serum urea nitrogen (> 7.1 mmol/L) and serum creatinine levels (> 123.8 µmol/L [> 1.4 mg/dL]). Radiography was performed on 7 patients during initial evaluation and 6 had evidence of gas present in the soft tissues. The clinical significance of this finding could not be evaluated statistically because of the small number of patients who underwent diagnostic x-rays. Two patients underwent Doppler ultrasound examination to rule out deep vein thrombosis in the involved extremity; however, the subtle signs of NSTI were not observed by the radiologist.

OUTCOMES

Six (20%) of our 30 patients died, with 4 of these deaths caused by septic shock occurring within 3 days of their initial presentation to the hospital. Three early deaths occurred in patients who presented late with advanced disease, despite timely debridement after hospital arrival. One patient developed sepsis after initial debridement and reexploration was not performed until after 72 hours, at which time more extensive necrosis was found. This patient was subsequently placed in the surgical intensive care unit and represents inadequate initial debridement. The 2 late deaths were due to multiorgan system...
failure secondary to overwhelming sepsis and occurred 18 days after hospital admission. Comparison of mortality from other recent series is given in Table 4. The mean hospital length of stay for all patients was 17.3 ± 17.7 days and the mean intensive care unit length of stay was 8.4 ± 14.5 days (Table 1). One survivor was an outlier and required prolonged intensive care unit stay (76 days) to recover from multiorgan system failure and upper-extremity amputation. Patients underwent an average of 3.1 ± 1.6 debridements. Reconstruction for the surviving patients involved application of split-thickness skin grafts in 11 patients and 2 patients required a myocutaneous flap. Three survivors of amputation had revision to a closed amputation stump.

Table 3. Pathologic Characteristics of Surgical Specimens

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of Patients</th>
<th>Skin</th>
<th>Fascia</th>
<th>Muscle</th>
<th>Bone</th>
<th>Amputations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper extremity</td>
<td>11</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Trunk/buttock</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Combined†</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>17</td>
<td>11</td>
<td>6</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

* Twenty of 30 patients had surgical specimens sent from the operating room.
† Combined category indicates lower extremity + trunk/buttock.

Table 4. Reported Mortality From Necrotizing Soft Tissue Infections

<table>
<thead>
<tr>
<th>Author</th>
<th>No. of Patients</th>
<th>Mortality, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudarsky et al²</td>
<td>33</td>
<td>6</td>
</tr>
<tr>
<td>Clayton et al⁶</td>
<td>57</td>
<td>18</td>
</tr>
<tr>
<td>Asfar et al⁷</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Ward and Walsh⁸</td>
<td>14</td>
<td>43</td>
</tr>
<tr>
<td>Wang et al⁹</td>
<td>18</td>
<td>33</td>
</tr>
<tr>
<td>Francis et al¹⁰</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>Chow et al¹¹</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Brown et al¹²</td>
<td>54</td>
<td>35</td>
</tr>
<tr>
<td>MCHenry et al¹³</td>
<td>65</td>
<td>29</td>
</tr>
<tr>
<td>Tsai et al¹⁴</td>
<td>54</td>
<td>22</td>
</tr>
<tr>
<td>Elliott et al¹⁵</td>
<td>198</td>
<td>25</td>
</tr>
<tr>
<td>Moss et al¹⁶</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Bosshardt et al¹⁷</td>
<td>45</td>
<td>27</td>
</tr>
<tr>
<td>Singh et al¹⁸</td>
<td>55</td>
<td>27</td>
</tr>
<tr>
<td>Cumulative Total</td>
<td>660</td>
<td>26</td>
</tr>
</tbody>
</table>

Two previous reports from this institution have documented the severity of upper-extremity NSTI and the bacteriologic features of these infections.⁹,²⁰ In the present study we selected critically ill patients with NSTI as a consequence of IVDU. During the last 3 years, we have observed a dramatic increase in the incidence of such infections and sought to determine whether any clinical factors would help us identify these serious infections. Bosshardt et al¹⁷ also reported a significant increase in the incidence of NSTI following illicit drug use in their recent review. Although we estimate that NSTI occur in only 1% of all the infections that underwent incision and drainage, the high mortality associated with progression of the infection warrants detailed examination.

Virtually all of the patients who manifested NSTI following IVDU presented to the hospital with some combination of induration, fluctuance, and erythema at the site of prior parenteral drug injection. Ordinarily these findings would be consistent with subcutaneous abscess; however, other typical signs of NSTI were generally not present. Only 5 of 30 patients had physical findings (ie, crepitance, skin necrosis, or bullae) suggestive of a NSTI. Pain is often used as a criterion for NSTI; however, most IVDU patients commonly report pain at the sight of a fluctuant abscess. All patients in our series reported pain and thus this symptom could not serve to differentiate. No other clinical signs were evident.

Clinical criteria observed on admission, such as systolic blood pressure, respiratory rate, heart rate, and temperature, were not seriously deranged for the entire group studied. Notable laboratory values that were more than 1 SD from normal were white blood cell count and serum albumin level. Five patients had APACHE II scores of 20 or above, 2 of whom died. Radiologic studies were not diagnostic of NSTI in our study. The signs of NSTI that can be observed on ultrasound include irregularity of the fascia, abnormal fluid collections along the fascia plane, and diffuse thickening of the fascia when compared with the control site in the normal limb.²¹ Others have reported on the efficacy of computed tomography²²,²³ and magnetic resonance imaging²⁴-²⁶ in diagnosing NSTI. Both are effective; however, the expense of these diagnostic approaches is not routinely justified for all patients presenting with subcutaneous abscess. Because diagnosis can be readily made at the time of surgery, preoperative studies would only be useful for distinguishing potential cases that might not require surgical exploration and could be treated by bedside incision and drainage or with antibiotics alone.
The overall mortality rate in our series of patients was 20%. The mortality rate reported for NSTI of all causes ranges from 3% to 43% (26% overall) for the series published in the last 10 years that are reviewed in Table 4.13-17 Analysis of the mortality in our series showed that 15% were early septic deaths and 5% were late deaths from multiorgan failure.

The pathologic findings in this study reflect a wide range of tissue damage (Table 3). In some cases, patients may have used oral antibiotics before arrival in the hospital, which could influence the pattern of organisms seen or may have masked clinical signs of infection. The diversity of clinical extent probably reflects the depth of injection by the patient, and may also reflect extended delay in presentation.

We observed similar bacteriologic isolates to those previously reported from our institution and to those reported by other series.10,12 Multiple-organism infections occurred in 59% of our cases, which is generally a lower number than reported in most series of NSTI of all causes (65%-85%).13-18 It is possible that the majority of NSTI may actually be mixed infections, and that inability to isolate multiple organisms accounts for the recorded cases of single isolates. This is suggested by Singh et al.,18 who concluded that NSTI are polymicrobial and no single bacterium is associated with a specific clinical entity. We could not determine retrospectively whether cultivation of anaerobes was performed with special handling of the specimens to ensure reliable culture results. Otherwise, the pattern of bacterial isolates was predominantly gram-positive isolates, followed by gram-negative isolates, anaerobes, and fungi. Like most other studies, we found that the most predominant organism was the skin isolate Staphylococcus, an organism commonly seen in subcutaneous abscesses. There were 5 patients with group A streptococci (recently popularized in the lay press for its virulence).27 Of these, 1 patient required an extremity amputation and died. The lack of more serious group A streptococci infections has been observed by others. Comparing the IVDU and non-IVDU groups, group A streptococci bacteremia in IVDU patients is associated with a more benign outcome, a longer time of evolution before diagnosis, and a lower frequency of septic shock and mortality than in non-IVDU patients.28 The remaining deaths were all a consequence of mixed isolate infections. This coincides with the experience classically reported by Melaney and confirmed by the meticulous prospective culture data of Singh et al.16

Others have reported that logistic regression can identify outcome-predicting factors. Bosshardt et al17 showed that temperature, extent of infection, and systolic blood pressure were predictors in their series of 45 patients. Alternatively, Elliott et al15 showed that a different set of independent variables including age, female sex, extent of infection, delay in debridement, elevation of serum creatinine level, elevated serum lactate level, and degree of organ system failure at onset were reliable predictors in a series of 198 patients. Based on these prior reports, we specifically tested most of these parameters (except delay in debridement and degree of organ system failure, which were not present in our series) for their ability to predict outcome. The failure of univariate analysis to identify factors that might predict outcome in this series is best explained by the small number of cases with serious infections (30 patients) and by the skewed mean variables included as independent predictors (ie, white blood cell count and creatinine level). Although our findings may reflect the fact that NSTI in drug users are less virulent and behave differently than infections that originate from other causes, it would be most prudent to study a larger sample before drawing firm conclusions in this population.

Necrotizing soft tissue infections continue to be a significant contributor to the number of serious infections that surgeons must manage. With the increasing numbers of illicit drug users in urban centers, surgeons must be prepared to deal with the sequelae of these infections to prevent the potentially high incidence of morbidity and mortality seen with this disease. We were unable to identify outcome predictive factors in this series. We were impressed with the high number of serious infections that presented without clinical indicators of such infections. Similarly, no other studies have identified factors that predict progression of simple abscess to a NSTI. Consequently, a heightened awareness of the possibility that this disease entity may be masquerading as a simple infection must be maintained. While we may continue to make advances in the technology of diagnostic tests, in the end it will be a strict adherence to the traditional approach of aggressive debridement and supportive care that will ultimately prevail against such infections.

Presented at the 69th Annual Session of the Pacific Coast Surgical Association, Maui, Hawaii, February 15, 1998.

Reprints: Jan K. Horn, MD, San Francisco General Hospital, Department of Surgery, 3A, 1001 Potrero Ave, San Francisco, CA 94110 (e-mail: jhorn@sfghsurg.ucsf.edu).

REFERENCES

DISCUSSION

Claude H. Organ, Jr, MD, Oakland, Calif: We called to your attention at the 1996 meeting of the PCSA our experience with necrotizing fasciitis and the deadly disease this could be. This presentation by our colleagues is typical of what we expect from San Francisco General Hospital and fortunately mirrors our own experiences. Emphasis is stressed again that this condition presents as a diagnostic dilemma, which often occurs with a benign overlying-appearing skin that masks severe underlying tissue infection. In addition, the wound is difficult to assess, and indeed in 6 of the 7 cases in one of their categories there was gas in the subcutaneous tissue with the use of radiograms. Their use in the manuscript of the Doppler to identify venous thrombosis is certainly an excellent one.

The recent epidemic of cellulitis, abscess formation, and necrotizing soft tissue infection, often leading to amputation, has been fueled by the introduction of black tar heroin originating from Mexico using noncommercial-grade processing methods that are not standardized. The purity of the product on the street varies from 20% to 80%. Two schools of thought currently exist regarding its virulence: (1) black tar heroin has a high water content; it is highly hygroscopic and supports the concept of bacterial growth and (2) that soil is used in the manufacturing or storage of black tar heroin.

Many times these patients were HCV positive, and the infection might unmask a compensated liver process to decompensated cirrhosis. Many times these people will present without an obvious indication that they have an abscess. I noticed in your data that the percentage of patients with fluctuance, which was one of your clinical signs of an abscess, appeared to be less than 30%. So let's take the patient whom I see not uncommonly, and that is an intravenous drug addict "skin popper" who comes in with an area of induration and erythema. He is not clinically septic. You tap it with a needle perhaps, and you don't get any pus. How do you manage this patient? Do you take all of these patients to the operating room for an incision and drainage? Do you get special studies? How do you manage the majority of these patients I see who don't have an obvious abscess and don't have an identifiable area of fluctuance, just induration and erythema?

F. William Heer, MD, San Francisco: I would like to make 2 observations and 1 recommendation. The history of black tar heroin abuse in the presence of cellulitis is an indication for operation. Because of the era of managed Medicaid, a large number of such patients are showing up in private hospital emergency rooms in San Francisco. The problem that arises is that the patient ends up in the care of primary doctors who are unable to recognize and aggressively treat this disease. This approach has reduced the SICU stay by 50%.

We are in concurrence with the basic diagnostic and therapeutic approaches of Dr Schecter's group. Illicit drug abuse continues to be a major problem in our community, and we seem almost incapable of effectively dealing with this. Perhaps we need a special prosecutor just for drug abuse and where it leads to. Finally, (1) we must cooperate with public health officials in reporting these cases; (2) social workers should strongly advise drug abusers to keep their tetanus immunizations current; and (3) we should follow up more urgently on Dr Yellin's suggestion from the 1996 meeting that there be a multi-institutional study with the county hospitals in California on this topic.

Nancy L. Ascher, MD, San Francisco, Calif: I was wondering if the authors have had an opportunity to look at the HCV status of the patients. I would anticipate with this etiology of necrotizing infection that a substantial number of patients were HCV positive, and the infection might unmask a compensated liver process to decompensated cirrhosis.

Stanley R. Klein, MD, Torrance, Calif: I commend the authors for bringing this information to our attention. I would like to ask them for their recommendation(s) in this era of patient transfer. Clearly with this entity, time counts. How do you go about stratifying patients with soft tissue infection prior to transfer from referring physicians? Specifically, which factors do you, as the treating surgeon, desire to know prior to referral?

John K. MacFarlane, MD, Vancouver, British Columbia: I wondered if the authors could enlarge on any imaging techniques that they may have found useful in the diagnostic dilemma of some of these patients.

Clayton H. Shatney, MD, San Jose, Calif: Many times these people will present without an obvious indication that they have an abscess. I noticed in your data that the percentage of patients with fluctuance, which was one of your clinical signs of an abscess, appeared to be less than 30%. So let's take the patient whom I see not uncommonly, and that is an intravenous drug addict "skin popper" who comes in with an area of induration and erythema. He is not clinically septic. You tap it with a needle perhaps, and you don't get any pus. How do you manage this patient? Do you take all of these patients to the operating room for an incision and drainage? Do you get special studies? How do you manage the majority of these patients I see who don't have an obvious abscess and don't have an identifiable area of fluctuance, just induration and erythema?
David Tapper, MD, Seattle, Wash: Dr Schecter, in children with necrotizing fasciitis, Streptococcus is usually the offending organism and white count and heart rate are significantly elevated, indicating the need to proceed with debridement. I noticed that was not true in your group. I would ask 3 questions: Wouldn’t it be more prudent in this population to operate when induration is present? Secondly, does the use of hyperbaric or localized hyperbaric oxygenation have any effect? Finally, I was surprised at your choice of antibiotics. With so many of these people having staphylococcal infections, would a better combination be one that included nafcillin and a clindamycin rather than some of the ones that you have chosen?

Lawrence W. Way, MD, San Francisco: I have a question about methodology. Why was admission to the ICU used as a criterion for inclusion? There must have been other patients with necrotizing infections who did not need ICU care, and the conclusions would probably have been different if they had been part of the analysis.

Dr Horn: First of all, Dr Organ, we appreciate your comments and we have shared the experience that you have had over many years. This is not the first report from San Francisco General. You will recall back in the mid 1970s Dr Frank Lewis and Dr F. William Blaisdell presented data on some of the bacteriology of these infections to this society.

We also have been very concerned about black tar heroin, and it seemed like there was an epidemic of this in 1996 during the spring months. What we characteristic find in these infections is much more tissue necrosis than would ordinarily be suspected by the clinical findings, and I think this is what prompted us to begin this study. As you open up the tissues, you find deposits of this black material infiltrating throughout the tissues, and it seems as if the infection alone may not entirely explain the tissue destruction. It could be that there is an adjuvant effect of the materials in the heroin that may promote further destruction of the tissues.

We are concerned about the cost to society, and we believe that this is a serious public health problem which perhaps is going to be best addressed by multi-institutional approaches and better information for our colleagues.

With regard to questions by Dr Ascher, we did not determine the hepatitis C status of these patients. We do know that only 2 of them were HIV positive, and 6 others were negative by testing. For the remainder, there was no determination on that. Overall, 40% of the addicts who are seen at San Francisco General Hospital are hepatitis C positive. So this could be a serious concern with regard to their liver function. I think that is a good point.

Dr Klein, we agree with you that time is of the essence. Many of these patients linger in the streets and don’t come to the hospital until much later in the course, allowing for the progression. I think most people would believe that these infections take several days to really manifest. The message for our colleagues again is going to be that illicit drug users are a high risk population for serious infections, and perhaps that ought to be the trigger for specialty treatment and surgical care.

Dr Holcroft asked about the range of motion sign and, although this has not been reported as a specific indicator in the literature, I think it ties in with the painful aspect of this disease. Most of these patients often report pain that is out of proportion to the other clinical signs that are present, and that may be why this sign was missed when initially examined.

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Callahlan and colleagues describe a group of 30 patients seen during 5 years at San Francisco General Hospital with NSTI from illicit drug injections. This small, but remarkable, subgroup of 3560 patients with cutaneous abscesses from illicit drug injection experienced a 20% mortality. The authors, having sought clinical clues to differentiate patients with NSTI from those with simple cutaneous abscesses, concluded that a high index of suspicion and an inquisitive operative approach were necessary to avoid missing these serious infections.

A similar group of patients with NSTI from illicit drug injection was previously reported by the University of California, Davis–East Bay surgical group. High mortality (27%) and lack of specific clinical findings to differentiate serious infections from simple cutaneous abscesses were also noted by this group. Accordingly, a protocol was instituted that initiated early aggressive surgical debridement and early reoperation to arrest infection for all patients in this well-defined at-risk group. Since the report of the first 45 patients who experienced a 27% mortality, 90 additional patients have been treated, with a mortality of only 7%. The significant reduction of mortality since 1995 justifies the aggressive surgical approach to these patients.

Nonoperative clinical findings are unlikely to differentiate simple cutaneous abscesses from NSTI. The fascia is the primary site of infection and cannot be reliably assessed by nonsurgical means. Operative debridement of all cutaneous abscesses in high-risk patients along with an operative assessment of the extent of infection reflects good surgical judgment and saves lives.

The consistent report of black tar heroin use and the escalating frequency of these infections reflect a true public health emergency. Black tar heroin has emerged as the common thread among patients in major metropolitan regions of the West Coast presenting with NSTI. How and why black tar heroin contributes to NSTI deserves specific public health scrutiny.

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If at birth the cord is cut very short, (a) urine will escape from the umbilicus, if the urachus is patent; (b) feces, if the vittelo-intestinal duct is patent; and (c) the peritoneal cavity will be opened, if the extra-embryonic celom is patent.