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Seroma Management After Spinal Cord Stimulator Placement: A Case Series and Literature Review

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Background: Seromas, an uncommon complication of spinal cord stimulator (SCS) implants, can result in patient distress, increased office visits, and infection with eventual system explantation. Due to the rarity of this condition, diagnostic and treatment strategies are rather limited within the interventional pain field.

Methods: A retrospective chart review was performed on patients who underwent SCS implant, from January 2014 to June 2019, at our academic center. Management of SCS implantation complicated by a seroma is described.

Results: Out of 215 SCS implanted patients, 4 (1.9%) were complicated by a seroma. Seroma severity varied widely. Management varied from conservative management without intervention to evacuation, to moving the generator pocket, and to explantation due to a seroma infection and later replacement of the SCS.

Conclusions: The management strategy of a post-SCS implant seroma varies based on the progress of the seroma formation. Close follow-up with evolving treatment is necessary to prevent further complications.

Key words: Spinal cord stimulator, pain management, chronic pain, seroma, complication

BACKGROUND

Spinal cord stimulators (SCS) are common treatments for chronic pain syndromes (1,2). Seroma, a potential complication after SCS implant, has an incidence varying from 0.4% to 7% (3-6). Several variables contribute to the seroma formation, including the formation of an irregularly shaped pocket with free space surrounding the implantable pulse generator (IPG), excessive mobility of the IPG within the pocket, the body's physiological response to a foreign object, lymphatic disruption, and surgical site inflammation (7). If not promptly managed, a seroma can become infected, possibly requiring stimulator explantation. The incidence of seromas from SCS implantation is reported, but specific case reports are lacking. In this series, we present 4 post-SCS seroma cases at our institution and discuss the management utilized.

METHODS

An Institutional Review Board (Augusta University) approved a retrospective chart review, which was performed on all patients who had SCS implantation, from January 2014 to June 2019, at our academic center. Data collection includes patient demographics, operative data, outcomes, reoperations, and follow-ups.

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RESULTS

A brief patient demographic is demonstrated in Table 1. A detailed depiction of each patient's course and management follows:

Case 1: A 55-year-old woman received SCS implantation for severe complex regional pain syndrome type I. On postoperative day 4, a well-healing incision was observed upon examination during a regular follow-up visit. Her postoperative course changed when she fell and twisted her back on postoperative day 6. She returned on postoperative day 11 with a 1 cm fluid collection (by ultrasound) over the battery site. The patient reported no fevers or chills. No erythema or tenderness was appreciated on exam. The swelling continued to fluctuate during a 2-week follow-up period. Eventually, site exploration was performed and 3 mL of straw-colored fluid was evacuated. After careful examination showing no further collection or signs of infection, the pocket was thoroughly irrigated and closed. Cultures were negative. There were no complications or recurrence after the evacuation.

Case 2: A 62-year-old woman had a SCS implanted for lumbosacral radicular pain with an unremarkable initial course. On postoperative day 46, she presented to the emergency department reporting increased swelling and mild pain over the SCS incision for the past 2-3 days. She denied fevers, chills, or worsening back pain. On examination, the site had no erythema or expressive purulence. She reported a 70%-80% improvement of her pain from the stimulator. The patient was asked to monitor the site and follow-up 3 days later. Upon return, the patient reported an increased tenderness over the battery site (Fig. 1). Ultrasound examination identified a 7 x 8 x 1.5 cm fluctuant mass. Neuroradiology was consulted for an image-guided aspiration which removed 60 mL of serous fluid, negative for B2 transferrin and cultures. The area expanded again shortly after aspiration, so a seroma evacuation and SCS revision were conducted. During the procedure, 30 mL of straw-colored fluid was drained from a loculated area with no signs of infection. Due to the poor health of the surrounding tissue, the initial pocket was closed and a new IPG pocket was created at an alternative site. Aerobic and anaerobic cultures again returned negative. The patient returned to our clinic with an uneventful recovery and endorsed 90% relief of pain at her 6-month follow-up.

Case 3: A 54-year-old man underwent SCS for chronic lumbosacral radicular pain with an unremarkable initial course until day 34 when he presented to clinic complaining of gradual swelling at the surgical site. Mild tenderness without erythema or signs of purulence was present on physical exam. Ultrasound examination demonstrated a 1 x 2 x 1 cm fluid collection over the battery. The patient was treated conservatively with antibiotics and observation. The size of the seroma decreased significantly in 2 weeks and eventually resolved without recurrence.

Case 4: A 63-year-old woman underwent SCS implantation for chronic lumbosacral radicular pain with an unremarkable initial course until 2 months after implantation she bumped the area surrounding the generator and experienced discomfort and swelling at the site. She denied fever and chills, but after 2 weeks of close follow-up she returned to the clinic with complaints of worsening pain and erythema at the IPG site. The surgical area was diffusely erythematous with surrounding edema and marked tenderness upon palpation. Wound exploration revealed a grossly infected pocket with surrounding purulent fluid. The wound cavity measured approximately 10 x 8 x 3 cm, extending down to muscle fascia at the base and subcutaneous adipose tissue in the periphery. Surrounding soft tissue did not appear necrotic, however, there was significant cellulitis pres-

Table 1. Patient demographics.

Case	Gender	Age (y)	BMI	Diabetic (Yes/No)	Smoker (Yes/No)	Onset (d)	History of Trauma	Treatment and Outcomes
1	W	55	25	No	No	6	Fall and Twisted Back	Wound Exploration
2	W	62	27	No	No	46	No	Aspiration, Wound Exploration, and IPG Revision
3	M	54	31	No	No	34	No	Conservative and Resolved
4	W	63	35	No	Yes	60	IPG Site Was Bumped	Infected, Wound Exploration, and Device Removal

Abbreviation: BMI, body mass index; W, woman; M, man.

ent. The entire SCS system was removed and the abscess cavity was thoroughly irrigated and eventually closed. The patient had uncomplicated SCS reimplantation 6 months later.

DISCUSSION

A seroma is a pocket of subcutaneous noninfective exudate that forms at a surgical site (8). The pathophysiology of a seroma is not well understood, but thought to be due to aggressive handling of tissue, including excessive use of cautery, blunt dissection, and/or retraction. Suboptimal closure technique with persistence of dead space at the surgical site can also contribute to a seroma formation. In the interventional pain field, a seroma is an uncommon complication that may result in increased clinic visits, interventions, and increased financial costs. There is paucity of data or guidelines for management of a seroma following SCS implantation.

Though there is a lack of SCS implant-related seroma data or guidelines, studies in other surgeries, such as breast augmentation, do exist. High body mass index (BMI), large implant size, a submammary pocket, and smoking are all factors associated with seroma development in breast surgeries, but smoking was the strongest and amplified the effects of the other factors (7). Age and pocket size did not contribute to a seroma risk (7). In 400 breast augmentation patients, there was a significant correlation between larger implant size and postoperative complications (9). Another study (5) found that implant size was the only significant factor associated with surgery even when factors, such as age, height, BMI, smoking, or alcohol consumption, were taken into consideration. Multiple strategies to reduce a seroma risk exist, including preoperatively optimizing comorbidities, like diabetes and smoking, and intraoperative techniques, including limiting aggressive blunt dissection, avoiding excessive electrocautery, maintaining hemostasis, and performing a layered closure to limit dead space (3).

In our patient population, 4 out of 215 (1.9%) implanted patients developed or experienced a seroma following implantation, which is within the range reported for other surgeries (9). These cases included no diabetic patients and one active smoker. BMIs were 25-35. Seventy percent of our seroma cases required wound exploration with or without revision. This is a higher frequency of cases requiring exploration than for breast implant seromas (~20%) (9). None of the revised cases formed a second seroma in over a year of follow-up. Unique to our cases was the repeated history of trauma to the IPG site and subsequent development of a seroma in 2 out of 4 cases. We postulate that a fall or local trauma may increase the risk of a seroma formation by manipulating tissue at the surgical site with resulting traumatic contact to the surrounding tissue by the IPG. Therefore, protection of the IPG site and appropriate activity restriction in the first 2-3 months may minimize a seroma formation. Regarding surgical techniques to reduce a seroma occurrence, the debate of blunt vs sharp dissection remains controversial (6). No matter what technique is utilized, avoiding aggressive traumatization of the tissue and sustaining adequate hemostasis is paramount. An appropriately sized IPG pocket avoids excessive motion and contact between

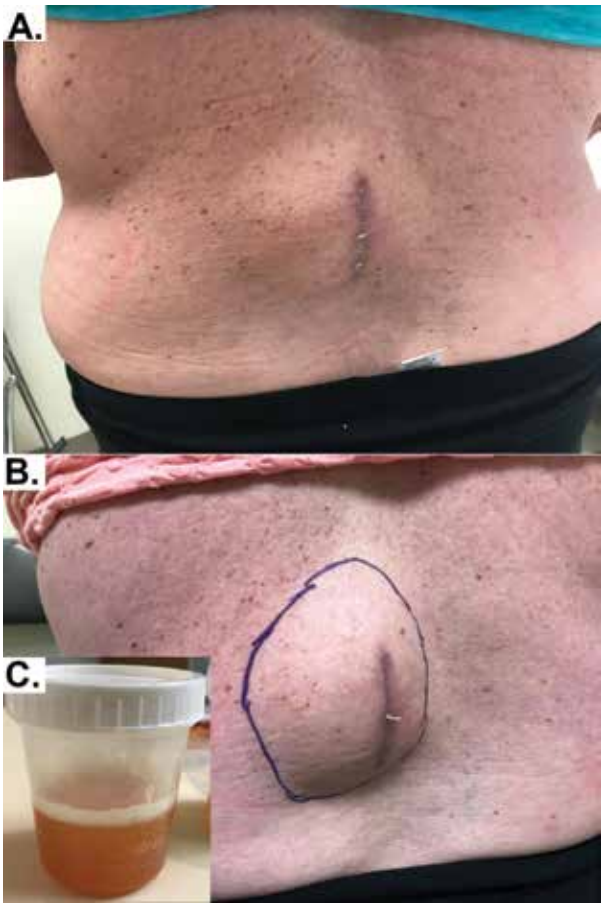

Fig. 1. A: Initial presentation of a seroma following neurostimulator placement. B: The same seroma grew significantly in 3 days follow-up. C: Serous fluid aspirated from the seroma.

the battery and the subcutaneous tissue. Incidence of a seroma may be further reduced by placing an abdominal binder overlying the surgical site.

In SCS implants, seromas classically present as a swelling surrounding the IPG site with an appreciable fluctuance, occasional tenderness, or erythema, and without associated fever, pustular drainage, or signs of infection. Aspiration of straw-colored fluid with a negative analysis and culture is confirmatory. Diagnosis can also be confirmed by surgical exploration and drainage, again with culture and fluid analysis. Ultrasound is useful in diagnosis by demonstrating a well-circumscribed hypoechoic or anechoic lesion and can be used to monitor changes. Differential diagnosis includes infection, hematoma, and allergic reaction to the device. Pseudomeningocele is a rare but reported SCS implant complication that can arise from retrograde flow of cerebral spinal fluid (CSF) along the pathway of an intrathecally placed electrode (10). To rule out the possibility of a retrograde CSF flow-forming seroma, β2-transferrin levels should be measured in the aspirated fluid.

Seroma formation and wound dehiscence were reported as the earliest occurring complication of implantation, with a median time of 0.6 months after implant (11). In our patients, the earliest seroma occurred 6 days after implant and the latest occurred 2 months after surgery. The onset of a seroma, however, varies significantly. In a sample of 12,297 Medicare patients who had an open (via laminectomy) SCS placement, 50% of seromas occurred within 90 days postoperatively, the remaining 50% occurred within one year (12,13).

Once a seroma is diagnosed, the initial treatment is typically conservative management, including applying pressure over the seroma site with bandages or bracing. If the seroma persists or rapidly expands, needle aspiration can be considered. A risk-to-benefit ratio should be considered and a strict, sterile technique is required since aspiration can lead to infection. If the seroma fails to resolve following conservative treatment or infection is suspected, open incision and drainage may be necessary. To dilute any possible contamination, high-pressure, high-volume antibiotic irrigation should be implemented at the time of surgical exploration. If treating conservatively, close clinical follow-up is advised as seromas can potentially become infected. The common clinical signs and symptoms of infection include pain (75.4%), wound erythema (63.1%), wound drainage (49.2%), and/or wound swelling (30.8%) (14). When infected, fever and wound dehiscence presented in 26.2% and 21.5% of patient cases, respectively (14). One of our cases displayed worsening pain and wound erythema during follow-up with an infection being identified upon exploration. She remained afebrile and had no wound during follow-ups. One seroma resolved in our 4 cases with conservative treatment. However, conservative therapies failed in 2 other cases. Based on this observation, large or rapidly growing seromas are unlikely to resolve by themselves. If site health is in question, management should escalate quickly as early wound exploration may prevent further infection and whole SCS system removal, one of the costliest complications of SCS (15).

Upon infection diagnosis, it is important to determine if the device should be explanted or remain in place. No consensus has been reached at this time and explantation remains dependent on the clinical situation and the physician's judgment. Superficial infections can be managed with debridement and/or antibiotic therapy, but deeper infections generally require surgical revision or removal of at least some part of the SCS system. If there is no purulent or necrotic material in direct contact with the hardware during debridement, one may leave the device to avoid the financial burden of losing the device. If a deep infection is identified, part or all of the hardware will require explantation since antibiotic treatment alone cannot consistently resolve these infections. If the infection is confined to the IPG site, one may consider removing just the generator in addition to antibiotic treatment while leaving the leads in place. Unfortunately, this may make eliminating the infection more difficult and often requires subsequent lead removals (16). Therefore, once the infection appears to reside in deeper tissues and is near the implanted system, the surgical mantra of, "when in doubt, take it out" should be followed (3). Following system removal and resolution of infection, the patient can be considered for reimplantation. Any new device should be relocated to a position not previously involved in the infection (16-19).

As mentioned previously, aggressive tissue manipulation and inappropriate pocket size or dead space formed from suboptimal closure techniques may increase the risk of a postoperative seroma. These factors might be attributed to surgical skill and experience. Other implant disciplines have demonstrated a clear link between the level of experience of the operating surgeon and the rate of complications related to the implant procedure (20,21). Nonexperienced implanters were associated

with higher complication rates and occurrences of rare life-threatening complications (22). Most chronic pain physicians do not have a surgical background. Due to the increasing volume of implantable and interventional procedures in the field of chronic pain, our fellowship program adopted additional elective Neurosurgery rotations for fellows to further enhance their surgical training and skill. We believe comprehensive surgical training is vital to reducing surgical complications following SCS implantation.

CONCLUSIONS

Seromas are uncommon complications after SCS implantation. A close follow-up schedule can help physicians to detect changes and make quick management decisions following the development of a seroma. Small seromas may resolve spontaneously or with conservative measures. However, large or rapidly expanding seromas will unlikely resolve in this manner, and will require early wound exploration for treatment and prevention of further sequelae, such as infection and system removal.

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