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COMPLICATIONS OF JOINT, TENDON, AND MUSCLE INJECTIONS

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Abstract

Prevention of complications is one of the most important aspects of patient care in pain management. The objective of this study is to review documented complications in medical literature that are associated with interventional pain management, specifically those associated with joint, tendon, and muscle injections. We conducted Medline research from 1966 to November 2006 using keywords complication, injection, radiofrequency, closed claim, facet, zygapophyseal joint, sacroiliac joint, shoulder, hip, knee, carpal tunnel, bursa, and trigger point. We found over 35 relevant papers in forms of original articles, case reports, and reviews. The most common complications appear to be infections that have been associated with virtually all of these injections. These infections include spondylodiscitis, septic arthritis, epidural abscess, necrotizing fasciitis, osteomyelitis, gas gangrene, and albuginosis arthritis. Other complications include spinal cord injury and peripheral nerve injuries, pneumothorax, air embolism, pain or swelling at the site of injection, chemical meningism, granulomatous inflammation of the synovium, aseptic acute arthritis, embolism cutis medicamentosa, skeletal muscle toxicity, and tendon and fascial ruptures. We suggest that many of the infectious complications may be preventable by strict adherence to aseptic techniques and that some of the other complications may be minimized by refining the procedural techniques with a clear understanding of the relevant anatomies.

Introduction

The practice of chronic pain management has grown steadily in recent years. Consequently, prevention of complications should be one of the most important aspects of interventional pain management. This requires an adequate appreciation of the risks and complications associated with the procedures. It is difficult, however, to know the true incidence of complications. This is mainly due to the facts that such complications are usually under reported, that there is limited statistical analysis of such incidences, and that only a small fraction of such complications ends up in litigation. Fitzgibbon et al. (2004) analyzed data from 5,475 claims in the American Society of Anesthesiologists Closed Claims Project database between 1970 and 1999¹. They found that Claims related to chronic pain management increased over time and accounted for 10% of all claims in the 1990s. The frequency and payments of claims associated with chronic pain management by anesthesiologists also increased in the 1990s. Nerve injury and

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pneumothorax were the most common adverse outcomes in invasive pain management claims. The above mentioned limitations should always be aware of during risk/benefit analysis, obtaining informed consent, and predicting potential adverse outcomes of interventional procedures. We thus reviewed complications associated with the commonly performed joint, tendon, and muscle injections with the objective to help prevent some of these complications.

1. Facet joint injections

The zygapophyseal joints (facet joints) may be a significant source of back pain. Consequently, facet block is one of the most commonly performed procedures in chronic back pain management. It involves an intraarticular injection of local anesthetics with or without steroid. An alternative approach is to conduct diagnostic block of the medial branch of dorsal rami of the spinal nerves, followed by radiofrequency ablation of the nerve supply to the joint. Facet joint injection is generally considered to be a very safe procedure. However significant complications have been reported, including spinal cord injury associated with cervical facet injection and pneumothorax associated with thoracic facet injections. Other complications reported after facet injections include: spondylodiscitis², chemical meningism³, septic arthritis⁴, and epidural abscess⁵.

Spondylodiscitis is a rare complication after facet joint steroid injection². Falagas et al. (2006) reported a 78-y-old male with chronic back pain and facet joint arthritis who developed *Pseudomonas aeruginosa* spondylodiscitis at L2–L3 and L3–L4, after computed tomography-guided facet joint steroid injection. Magnetic resonance imaging, fine needle aspiration and cultures confirmed the diagnosis. The patient was treated with intravenous administration of amikacin, and imipenem plus cilastatin for 4 weeks, followed by oral administration of ciprofloxacin for another 10 weeks. The authors stressed sterile preparation prior to facet joint steroid injection for the prevention of this complication.

Thomson et al. (1991) reported a case in which chemical meningism occurred after lumbar facet joint block with methylprednisolone acetate and bupivacaine³. This complication was probably due to inadvertent dural puncture. The use of steroids in facet joint injections is questioned by these authors.

Septic arthritis of a lumbar facet joint with an associated paraspinal abscess is also a rare complication of facet joint injection with only three cases reported in the literature. Orpen and Birch (2003) reported a case of a 46-year-old, otherwise healthy, man with chronic lower back pain and no evidence of nerve root compression⁴. The patient underwent diagnostic facet joint injections and presented with a facet joint infection 2 months after the injection, in a manner that was indistinguishable from an acute intervertebral disc herniation. The diagnosis was confirmed on magnetic resonance imaging, and he was successfully treated with surgical debridement and antibiotics. The authors suggested that this diagnosis should be considered in patients who have undergone diagnostic facet joint injection who subsequently deteriorate with back and leg pain without another apparent cause. Alcock et al. (2003) reported a case in which facet joint injections resulted in epidural abscess formation⁵. This is probably the only such case reported. Although rare, epidural abscess is potentially very serious occurrence.

Radiofrequency denervation of facet is commonly performed to provide long term pain relief in patients who respond to diagnostic facet medial branch block with greater than 50% pain reduction. Most studies on lumbar radiofrequency neurotomy have reported no associated complications. The complications that have been previously reported relate to electrical faults and include 4 cases of small superficial burns due to insulation breaks in the electrodes, 2 cases of burns at grounding pad adhesion sites due to RF generator malfunction (Radionics Model RFG-34F), and 1 unexplained burn⁶. In a recent study, Kornick et al. (2004) reexamined the incidence of complications associated with fluoroscopically guided percutaneous

radiofrequency denervation of the lumbar facet joints⁶. Ninety-two patients received a total of 616 radiofrequency lesions during 116 separate denervation procedures. Six minor complications were identified, yielding a 1.0% overall incidence of minor complications per radiofrequency site. Complications included: 3 cases of localized pain lasting more than 2 weeks (0.5%) and 3 cases of neuritic pain lasting less than 2 weeks (0.5%). No cases of infection, new motor deficits, or new sensory deficits were identified. They concluded that fluoroscopically guided percutaneous radiofrequency denervation of the lumbar facets is associated with an overall 1.0% incidence of minor complications per lesion site.

2. Sacroiliac Joint injections

Sacroiliac joint-mediated pain is a distinct clinical entity. The prevalence of intraarticular pain arising from the sacroiliac joint in patients with low back pain has been estimated at 15% to 30%. Treatment of sacroiliac joint pain involves intraarticular injection of local anesthetics and steroids, radiofrequency ablation of the joint capsule, or radiofrequency neurotomy of the lumbosacral lateral branch nerves of the posterior primary rami of L5 and S1–S3. Interestingly, serious complications have not been reported after SI joint injections^{7–9}.

3. Hip injections

Hip is a site very commonly affected by osteoarthritis (OA) and consequently, hip injection is commonly done to alleviate pain associated with this type of degenerative joint diseases. Air embolism has been reported in pediatric patients during hip joint arthrography. As an aid to correctly placing the needle tip within the hip joint during arthrography, injection of small amounts of air has been used to outline the joint space. The authors noted, over a period of seven years, air embolus in three pediatric patients, twice with minor symptoms, and once with cardiac arrest. They concluded that even small amounts of air (less than 5 cc) injected accidentally intravenously may cause dangerous complications in small infants. Fortunately, this complication has not been reported in adult population. If this technique is to be used, it is recommended that small amounts of carbon dioxide or oxygen be used instead of air.

Further, steroid injection of the greater trochanteric bursa is commonly conducted for bursitis and hip pain. It is generally a safe procedure, but not without complications¹⁰. Hofmeister and Engelhardt (2001) reported a case of necrotizing fasciitis developing from a single steroid injection of the greater trochanteric bursa. Necrotizing fasciitis is a limb- and life-threatening soft-tissue infection that frequently involves the extremities. Despite early resuscitation and aggressive surgical management that included a hip disarticulation, the patient expired in that case.

4. Knee injections

Recently, intra-articular viscosupplementation with hyaluronate-derived products has gained popularity as a palliative modality for the treatment of osteoarthritis of the knee. Knee joint steroid injection is also commonly performed for pain management of osteoarthritis. Although several techniques have been described, it is usually performed by either medial or lateral approach with the flexed affected knee. Complications of knee injections have been related to pain or swelling at the site of injection¹¹, granulomatous inflammation of the synovium¹¹, saphenous neuropathy¹², aseptic acute arthritis^{13, 14}, septic arthritis^{15–17}, embolia cutis medicamentosa (Nicolau Syndrome)¹⁸, and albicans arthritis¹⁹.

Mild pain or swelling at the site of injection may occur in up to 20% of patients, although severe local inflammation, warmth, and joint effusion are rare¹¹. Chen et al. (2002) reported a series of six cases in which granulomatous inflammation of the synovium was observed after hyaluronate viscosupplementation of the knee. They examined six knees in five patients treated

with intra-articular Hylan G-F 20 viscosupplementation underwent a surgical procedure because of persistent symptoms. Routine histopathological evaluation, supplemented by alcian-blue staining and hyaluronidase digestion, was performed in each case. Chronically inflamed synovium with areas of histiocytic and foreign-body giant-cell reaction was observed surrounding acellular, amorphous material. The material stained with alcian blue, a stain for hyaluronate, which disappeared after hyaluronidase digestion. It is suggested that the injected hyaluronate (Hylan G-F 20) may be responsible for the synovitis and thus may be a pathological cause of recalcitrant symptoms after such injection. However, it is not known whether the responsible pathological agent was the hyaluronate derivative, a contaminant of the purification process, or a component of the carrier substance. Importantly, it appears that the findings in these patients most likely represent a previously unreported pathological response to a viscosupplementation product.

Iizuka et al. (2005) presented a case of obese patient who developed saphenous neuropathy following knee joint injection via medial approach¹². The clinical picture suggests that the needle pierced the nerve during the procedure. This complication should be considered when performing knee joint injection, especially when the patient is obese and the anatomic landmarks are obscured.

Aseptic acute arthritis can develop within hours after injection¹³. Based on standard crystal analysis, calcium crystal shedding has been postulated to explain this complication. However, it is not known whether apatite crystals or low amounts of calcium pyrophosphate dihydrate (CPPD) crystals are also involved as to determine this requires a complete synovial fluid (SF) analysis. Two cases of such an acute arthritis are reported in patients after receiving a second intra-articular injection of Hylan GF-20. The SF did not contain CPPD, monosodium urate, or calcium apatite microcrystals as examined by microscopic analysis using a compensated polarized light microscope after alizarin red staining. Further studies are required to investigate possible direct proinflammatory effects of hyaluronic acid degradation products.

Roos et al. (2004) reported a case of acute arthritis after intraarticular injection of sodium hyaluronan (Ostenil) in a 70-year-old woman with a history of knee osteoarthritis¹⁴. The joint fluid was purulent, with no crystals, and laboratory tests showed marked inflammation, leading to antibiotic treatment for suspected septic arthritis. Incapacitating symptoms persisted, prompting surgical lavage of the knee, which failed to relieve the severe pain. The persistent symptoms and negative results of joint fluid and blood cultures led to discontinuation of the antibiotic therapy after 10 days. Anti-inflammatory therapy relieved the symptoms, and the patient was discharged home 1 month after her admission. Nevertheless, the pain persisted, requiring rehabilitation therapy of the knee. It is suspected that aseptic arthritis induced by repeated sodium hyaluronan injection is the most likely diagnosis.

Further, septic arthritis has been reported after intra-articular steroid injection¹⁵. In a survey of 100 orthopedic surgeons, 100 rheumatologists, and 50 general practitioners in the United Kingdom, 24 respondents (12.6%) had encountered septic arthritis after steroid injection of the knee (18 once, 3 twice, 2 three times, 1 several times). There is a wide variation in the precautions taken to avoid such a complication, 57.6% of the respondents used alcohol swabs to clean the skin, and the remaining 42.4% used chlorhexidine or Betadine. Only 16.3% used sterile towels to isolate the injection site. There were 32.5% of respondents who routinely used sterile gloves when injecting and a total of 46.6% used either sterile or non-sterile gloves. Also, 91.1% changed needles between drawing the steroid and injecting it into the joint. It is not clear whether the minimal use of antiseptic techniques is responsible for the septic arthritis reported.

Lequerre et al. (2002) reported a case of *actinomyces naeslundii* septic arthritis developed after intra-articular injection of hyaluronate in a man with osteoarthritis of the knee¹⁶. *Actinomyces* is an anaerobic Gram-positive rod. The patient was treated successfully with two antibiotics and arthroscopy. The nature of the organism and its location to a joint are unusual features of this case, which illustrates the need to search for a septic complication before accepting a diagnosis of inflammation related to hyaluronate injection.

Evanich et al. (2001) reported one case of septic arthritis among 80 knees with symptomatic osteoarthritis treated with hyaluronic acid¹⁷. The authors recommend intraarticular hyaluronic acid only for symptomatic patients with significant surgical risk factors and for patients with mild radiographic disease who have failed to respond to conservative treatment such as physical therapy, weight loss, nonsteroidal anti-inflammatory medication, and intraarticular steroid injection. It is inadvisable to treat patients with a complete collapse of joint space or bone loss with intraarticular hyaluronic acid, given their poor clinical response.

Beissert et al. (1999) described a case of embolia cutis medicamentosa after intra-articular injections into the knee¹⁸. Embolia cutis medicamentosa (Nicolau Syndrome) is a very rare complication of intramuscular injections which presents with extensive necrosis of the injected skin area. Intra-arterial and/or para-arterial injections after prior perforation of certain vessels are considered as possible pathogenetic mechanisms.

Christensson et al. (1993) reported a case of *candida albicans* arthritis after repeated knee injection with saline¹⁹. This nonimmunocompromised 32-year-old man with arthrosis of the knee participated as a placebo control in a clinical trial of intraarticular injections of hyaluronan. After the fourth weekly injection of saline, he developed a warm and swollen knee, and synovial fluid cultures revealed growth of *Candida albicans*. Oral fluconazole treatment was instituted 2 weeks after onset of symptoms, but failed to eradicate the infection. The patient recovered after treatment with local and systemic amphotericin B, systemic 5-fluorocytosine and surgical synovectomy. Quantitation of joint cartilage proteoglycan fragments in synovial fluid indicated extensive breakdown of cartilage during the acute phase of arthritis but, parallel to clinical recovery, these levels returned to normal.

5. Shoulder injections

Shoulder injections include subacromial steroid injection and intraarticular injections. Although uncommon, infection is a significant complication of such injections. Impingement syndrome is a common disorder of the shoulder. Subacromial corticosteroid injection may be used when patients fail to respond to other forms of conservative treatments such as rest, ice/heat, anti-inflammatory agents, and physical therapy. The efficacy of this approach has been supported by a single blinded, randomized and controlled study which demonstrates that the corticosteroid injection provides additional benefit when used with other conservative treatment modalities in 48 patients with stage 2 subacromial impingement syndrome²⁰. A case of scapular osteomyelitis following subacromial corticosteroid injection has been reported in a 29-year-old man²¹. Successful treatment consisted of surgical debridement followed by a combination of intravenous and oral antibiotic therapy. Strict adherence to aseptic technique is emphasized for performing subacromial corticosteroid injection.

Birkinshaw et al. (1997) reported a case of necrotizing fasciitis as a complication of steroid injection of a painful shoulder in a previously healthy female²². This case highlights a very rare life threatening emergency after steroid injection. Early recognition, resuscitation, and aggressive surgical management are essential to prevent mortality in this condition.

Gas gangrene is a rare infectious disease syndrome complicating medico-surgical procedures. Yangco et al. (1982) reported a case of gas gangrene secondary to intra-articular steroid

injection²³. Clostridia species and *Escherichia coli* were the etiologic organisms in this case. The presence of underlying diseases such as diabetes mellitus, hepatic insufficiency, and metabolic acidosis could have contributed to the fatal outcome of this patient. A high index of suspicion, early diagnosis, and appropriate treatment may improve the prognosis in gas gangrene. Meticulous aseptic technique should always be observed in the performance of this procedure.

6. Carpal tunnel injections

Local steroid injections for symptomatic relief of carpal tunnel syndrome (CTS) have become common in the evaluation and treatment of this disorder. It is usually performed as a diagnostic aid in cases in which symptoms are atypical. It is also performed in patients with severe symptoms either who are awaiting surgery or in whom spontaneous remission might be expected. It can be a definitive treatment in patients who do not desire surgery. Injection is usually performed using proper technique by physicians skilled in carpal tunnel surgery or pain physicians. A soluble preparation of dexamethasone is recommended. Injury to the median nerve is a serious and fairly common complication of carpal tunnel injection^{24, 25}. Immediate paresthesia in the median nerve distribution or exacerbation of symptoms beyond 48 hours following injection is suspect for inadvertent nerve injury; therefore, early surgical exploration and/or decompression might be indicated.

Linskey and Segal (1990) reported a case of nerve injury from a steroid injection in a 24-year-old man with carpal tunnel syndrome that was successfully treated by incision of the transverse carpal ligament and neurolysis even though we do not think that neurolysis is the answer to peripheral nerve injury²⁵. The suggested means of avoiding this complication include careful attention to anatomic landmarks as well as to the patient's subjective response during injection and avoidance of the use of local anesthetics. On the other hand, using local anesthetics might augment the effect of the steroid and also results in a rapid pain relief.

Racasan and Dubert (2005, 2006) studied the safest location of the injection to avoid nerve injury^{26, 27}. They measured the distances between the median nerve, palmaris longus, flexor carpi ulnaris and flexor carpi radialis tendons pre-operatively, 1cm proximal to the distal wrist crease in 93 endoscopic carpal tunnel releases. They found that the median nerve extended ulnarly beyond the palmaris longus tendon in 82 hands (88%). It is concluded that the median nerve is at risk if the injection is performed within 1cm on either the ulnar or radial side of the palmaris longus tendon. More ulnarly, there is risk to the ulnar pedicle.

7. Injections for athletic injuries

The potent anti-inflammatory effects of the corticosteroids have led to their extensive usage in the management of athletic musculoskeletal injuries: sprains and strains, tendon injury, shoulder injury, rotator cuff disease, tennis elbow, and lateral epicondylitis. Nichols reviewed the risks of locally injected corticosteroids in the treatment of athletic injuries²⁸. He identified twenty-five studies that primarily examined the usage/efficacy of corticosteroid injections in the treatment of various athletic injuries. Of the 983 subjects who received corticosteroid injections in these studies, only minor complications of treatment were reported. He found eighteen selected studies that primarily described complications of corticosteroid injections in the treatment of athletic injuries. Of these, tendon and fascial ruptures were the predominant complications reported. He concluded that the existing medical literature does not provide precise estimates for complication rates following the therapeutic use of injected corticosteroids in the treatment of athletic injuries. Tendon and fascial ruptures are often reported complications of tendon/articular corticosteroid injections, particularly in the case of Achilles tendon.

8. Trigger point injections

Trigger-point injection therapy is a common procedure in pain management, primary care medicine, and emergency medicine and is generally considered safe. However, serious complications have been reported. These complications include pneumothorax^{1, 29}, intrathecal injection³⁰, epidural abscess³¹, and skeletal muscle toxicity (Zink and Graf, 2004) to name a few. Among the 276 claims associated with invasive procedures for chronic pain management in the American Society of Anesthesiologists Closed Claims Project, 17 cases involve trigger point injections¹. Pneumothorax is the most common outcome of trigger point injection claims, accounting for 15 claims.

Nelson and Hoffman (1998) reported a case of intrathecal injection in a 28-year-old woman who experienced respiratory depression and hemiplegia after the injection of a superficial trapezius trigger point³⁰. The patient required emergency tracheal intubation and ventilatory support. Head CT revealed pneumocephalus. She recovered fully over the course of 24 hours.

Skeletal muscle toxicity is a rare and uncommon side effect of local anesthetic drugs. Intramuscular injections of these agents regularly result in reversible myonecrosis. The extent of muscle damage is dose dependent and worsens with serial or continuous administration³². All local anesthetic agents that have been examined are myotoxic, whereby procaine produces the least and bupivacaine the most severe muscle injury. The histologic pattern and the time course of skeletal muscle injury appear rather uniform: hypercontracted myofibrils become evident directly after injection, followed by lytic degeneration of striated muscle sarcoplasmic reticulum, and by myocyte edema and necrosis over the next 1 to 2 days³². Myoblasts, basal laminae, and connective tissue elements remain intact in most cases, which permit muscular regeneration within 3 to 4 weeks. Subcellular pathomechanisms of local anesthetic myotoxicity are still not understood in detail. Increased intracellular Ca^{2+} levels appear to be the most important element in myocyte injury; since denervation, inhibition of sarcolemmal Na^{+} channels, and direct toxic effects on myofibrils have been excluded as sites of action³². Although experimental myotoxic effects are impressively intense and reproducible, only a few case reports of myotoxic complications in patients after local anesthetic administrations have been published. In particular, the occurrence of clinically relevant myopathy and myonecrosis has been described after trigger point injections and other procedures such as continuous peripheral nerve blocks, infiltration of wound margins, and after peri- and retrobulbar blocks³².

In summary, various complications are associated with many of the interventional procedures involving injections of facet, sacroiliac, hip, knee, and shoulder joints as well as carpal tunnel injection and trigger point injection (table 1). The most common complications are infections that have been associated with almost all of these injections. These infections include spondylodiscitis, septic arthritis, epidural abscess, necrotizing fasciitis, osteomyelitis, gas gangrene, and albicans arthritis. Other complications are non-infectious and include spinal cord injury and peripheral nerve injuries, pneumothorax, air embolism, pain or swelling at the site of injection, chemical meningism, granulomatous inflammation of the synovium, aseptic acute arthritis, embolia cutis medicamentosa, skeletal muscle toxicity, and tendon and fascial ruptures. Further, Intrathecal injections are associated with trigger point injections, chemical meningism with facet block, pneumothorax with facet injections and trigger point injections, infections with facet and other joint injections, aseptic arthritis with knee intra-articular viscosupplementation, and nerve injuries with facet injection, carpal tunnel injection, and knee injection. Many of these complications may be prevented by observing strict aseptic techniques and by performing the procedures with clear understanding of the anatomy and the techniques. Adequate monitoring, early detection, aggressive treatment, and accurate documentation are required when complications do occur to minimize the adverse outcomes.

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Table 1
Complications of joint, tendon, and muscle injections

Injections	Complications	References
Facet	Spinal cord injury Pneumothorax Spondylodiscitis Septic arthritis Epidural abscess Chemical meningism	Fitzgibbon et al. 2004 Fitzgibbon et al. 2004 Falagas et al. 2006 Orpen and Birch, 2003 Alcock et al. 2003 Thomson et al. 1991
SI joint	No reported complications	N/A
Hip and greater trochanteric bursa	Necrotizing fasciitis Air embolism	Hofmeister and Engelhardt, 2001 McCauley et al. 1981
Knee	Pain or swelling at the site of injection Granulomatous inflammation of the synovium Saphenous neuropathy Aseptic acute arthritis Septic arthritis Embolia cutis medicamentosa Albicans arthritis	Chen et al. 2002 Chen et al. 2002 Iizuka et al. 2005 Bernardeau, 2001; Roos et al. 2004 Charalambous et al. 2003, Lequerre et al. 2002; Evanich et al. 2001 Beissert et al. 1999 Christensson et al. 1993
Shoulder	Osteomyelitis Necrotizing fasciitis Gas gangrene	Buckley et al. 1989 Birkinshaw et al. 1997 Yangco et al. 1982
Carpel tunnel	Median nerve injury	Linskey and Segal 1990
Injections for athletic injuries	Tendon and fascial ruptures	Nichols, 2005
Trigger point	Pneumothorax Intrathecal injection Epidural abscess Skeletal muscle toxicity	Shafer, 1970; Fitzgibbon et al. 2004 Nelson and Hoffman 1998 Elias 1994 Zink and Graf 2004