Emergency Protocols for the Spinal Injectionist

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This second of two articles addresses the fact that emergencies arise so infrequently that physicians don't think about or practice emergency protocols in advance and offers suggestions for being prepared to handle complications during spinal interventional procedures.

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On January 15th, 2009 there was a bright blue sky over the Hudson River. This was the backdrop to one of the most dramatic airline emergencies in history. Prior to take-off in New York City, everything was normal. There was nothing during pre-flight inspection that gave cause for alarm. A maintenance check required every 550 flight hours had recently been performed. However safety inspections were not enough to prepare them for what happened next.

The plane took off from Runway 4 at 3:25pm, to begin its ascent to 15,000 feet. However, at 3,200 feet, the plane's windscreen turned dark brown and the pilots heard several loud thuds. Both engines quickly lost power and the plane started its lifeless decent. Captain Sullenberger called to the air traffic controllers, "Hit birds; We've lost thrust on both engines." A migrating flock of Canadian Geese had flown into the airplane causing both engines to fail. "We're turning back towards LaGuardia," said the Captain to air traffic control. "Got emergency clearance if you want to try and land…" air traffic control reported. "Unable," replied Sullenberger, "…maybe Teterboro?" Teterboro airport in New Jersey was the closest airport en route with the airplanes current direction. Seconds later, Sullenberger reported: "We can't do it…we're gonna be in the Hudson."

Capt. Sullenberger navigated the unpowered plane into the Hudson River. Emergency rescue teams were immediately dispatched and all 155 occupants were safely evacuated as the plane flooded with water. Sullenberger was immediately recognized as a hero. However, he attributed his heroics to his many years of experience and training for emergencies in an airline simulator. He stated, "I think that it allowed me to focus clearly on the highest priorities at every stage of the flight without having to constantly refer to written guidance."

Memory Retention of Spinal Intervention Emergency Protocols

In the same way, spinal interventionalists should not only be qualified in providing expert procedural care but also in management of emergency situations that arise during performance of procedures. There is an implicit understanding between patient and physician that, should an emergency arise, the physician will be able to provide the care needed to resuscitate the patient. Last month's article in *Practical Pain Management*, entitled "Avoiding complications from interventional spine techniques," described the types of complications that can occur during a spinal injection.[1] The purpose of this article is to provide physicians with guidelines for resuscitation should the need arise. Finally, the authors hope to motivate readers to mentally and physically rehearse, on a regular basis, the steps necessary to provide appropriate care in an emergency.

The Advanced Cardiovascular Life Support (ACLS) guidelines have been the gold standard in preparing a physician to care for a patient in dire circumstances. However, a single rehearsal of the ACLS guidelines every two years has been shown to be insufficient for long-term retention of resuscitative care amongst healthcare providers.[2-5] Not only does retention of ACLS knowledge decrease with time but so does the quality of ACLS care. In a multi-parameter study of the quality of ACLS cardiopulmonary resuscitation, deficiencies in many parameters of ACLS care were noted including chest compression rate, compression depth, fraction of cardiac arrest time without compressions being performed and ventilation rate—even when well-trained staff performs resuscitation.[6] In order to be adequately trained and ready to provide the care needed for resuscitation, additional training is needed.

The American Heart Association (AHA) recommends a renewal of ACLS certification every two years to remain current in practice and skill.[7] However, studies have shown a rapid decline in ACLS knowledge and skill shortly after completion of training.[8-12] Many have argued that a frequency of every two years is not enough. This argument has been validated by a study showing that professional skills decay significantly with nonuse.[13] Arthur et al. expanded on the idea of increasing the frequency of trainings by performing a study using meta-analytical techniques. They found the most important criteria for skill and knowledge retention was the degree of overlearning.[13] This is defined as "additional training beyond that required for initial proficiency."[13] These findings suggest a need for continued education beyond the two-year minimum requirement and hint at the possibility that the method of learning can be improved in order to facilitate long-term recall.

The type of learning and training is important for retention of emergency protocols. In a study performed by Rodgers et al to assess written-examination proficiency versus ability to manage an emergency situation, the investigators found no correlation between the two, suggesting that just one method of learning is insufficient.[14] This situation is addressed in the ACLS course by involving students in the following activities: "simulated clinical scenarios; demonstrations by instructors or video; discussion and role playing; and practice in effective resuscitation team behaviors."[15] However, similar types of learning are rarely taken advantage of in a clinical setting.

To alleviate this problem, Bryan et al suggest that providers need to be actively involved in the emergency training learning process.[16] They recommend asking the providers for their preference in learning styles; whether they prefer a quiz-based, simulation, or oral presentation style, to name a few examples. One solution many providers prefer is simulation-based education that provides a hands-on mechanism for education and retention that has shown positive results.[17-20] This technology encompasses a wide variety of techniques to help students retain the material. For example, it can include the use of a video program to facilitate training (e.g., mannequins equipped with technology to provide feedback on the performance of a technique). In a retrospective study to assess the success of simulation-based technology, two groups of participants were monitored during real ACLS events. One group was trained with simulation-based technology and the other was trained through traditional methods. Those who were trained with simulation-based technology were 7.1 times more likely to adhere to ACLS guidelines than those who were trained traditionally (95% confidence interval).[21] The researchers concluded that simulation-based training is an effective tool to provide an advanced form of learning that can enhance retention and skill in many emergency situations.

However, many situations encountered in interventional pain are not specifically addressed in ACLS training alone. Problems encountered during interventional procedures—such as respiratory depression due to overdose of medication, high spinal anesthesia, seizures induced by injection of local anesthetic and others—require special training. ACLS guidelines can be performed for patients undergoing complications such as these however, according to ACLS guidelines, a differential diagnosis as to the cause of the emergency will allow the physician to effectively "search for, find, and treat reversible causes."[22] Accordingly, in the event that a complication from a spinal injection occurs, a treatment algorithm specifically created for such a situation can help to provide more directed care. Hence a firm knowledge of possible complications resulting from spinal injections and how to treat them should not only be understood but extensively rehearsed as well. Practice and education can effectively be addressed using simulation training and proper algorithms in a clinic setting. The repetition of such training can encourage retention amongst healthcare professionals.

Emergency Protocols

Performance of interventional procedures for the treatment of pain present a small but defined risk of severe medical emergencies requiring immediate and definitive action to prevent dire consequences. When such a situation arises, there is no time to look up treatment protocols, gather necessary resuscitation equipment and teach assistants proper techniques. In an emergency situation, where a patient's life hangs in the balance, all medical providers need to be prepared and capable of immediate and appropriate action. Because emergencies occur so infrequently, rehearsal is essential. Just like the pilot discussed earlier, appropriate action must be instinctual—i.e., the provider must immediately know what to do and how to do it.

The first step in providing appropriate care in an emergency is to develop a detailed action plan within the institution in which procedures are performed. This must be rehearsed at least monthly to be of any value. Every individual must be aware of their job during the emergency in order for things to run smoothly. The author performs procedures within an office environment, which is perhaps one of the more high-risk environments due to the lack of multiple ACLS trained personnel. For this reason, an action plan for emergencies is practiced monthly at our institution.

The second priority in handling emergencies is to have proper equipment that is tested daily prior to performance of procedures scheduled for the day. A crash cart and automated external defibrillator (AED) should be immediately available, all medications current, and all equipment in working order.

Finally, the emergency protocols must be memorized, rehearsed, and practiced on a regular basis. At the authors' institution, all providers are tested weekly on the emergency protocols and simulations are conducted monthly. These involve the entire office so that everyone has a chance to understand and rehearse his or her role during an emergency. A series of case studies are presented below followed by the appropriate emergency protocol needed to resuscitate the patient.

Case #1: Anaphylaxis

A 48 year-old female with a 2-year history of daily occipital headaches is referred to your office for evaluation. She was stopped at a traffic light when she was rear-ended by another automobile going approximately 30 mph. The patient's car was totaled. She was taken to the emergency room complaining of neck pain. She was evaluated and released after symptomatic treatment. Since the accident she has had daily headaches that fluctuate in intensity between 4 to10 out of 10. She has been under the treatment of her primary care physician who has been treating her medically with hy-

drocodone and a muscle relaxant. On presentation to the pain clinic, she complains of neck pain radiating to the posterior occipital region. She has been unable to work since the accident due to severe pain. She has tried treatment with physical therapy, chiropractic and massage. She went to 10-15 physical therapy visits and felt that it made her worse (she had more pain when she left and for several days thereafter). Both chiropractic and massage provided only short term relief. Physical exam reveals pain with palpation over the right greater than left C2-3 z-joints. Her MRI shows multi-level disc degeneration and a C5-6 left posterio-lateral disc protrusion. The pain physician recommends a medial branch block to confirm or refute the diagnosis of facet-mediated pain emanating from the C2-3 joint.

The patient is brought to the procedure suite for a medial branch block performed under flouroscopy. Approximately 30 seconds after injection of 0.5 cc of sarapin, the patient complains of difficulty breathing. In less than a minute, the patient is semiconscious, breathing is labored, oxygen saturation has dropped into the low 80s and BP is 90/50. You notice diffuse urticaria. Within a minute, the patient becomes unconscious. What is the diagnosis and appropriate treatment?

Suspect anaphylaxis in a patient with history of allergic reaction who suddenly develops shortness of breath, difficulty swallowing, facial swelling, erythematous rash, itching, and rapidly progresses to unconsciousness. Following is the recommended protocol for anaphylaxis:[23]

1. Call for help:
   a. call code over intercom
   b. call 911
2. Have AED and crash cart brought to room
3. Check airway:
   a. position patient supine
   b. open airway with head tilt-chin lift
   c. insert oral airway if apneic
4. Check for breathing:
   a. watch for chest rise, feel for breath, and listen for sound.
   b. if apneic, give 2 rescue breaths
5. Check circulation:
   a. check pulse
   b. if no pulse, start chest compressions until AED arrives
   c. as soon as AED arrives attach and follow instructions
6. Check vital signs q 2 minutes:
   a. blood pressure
   b. heart rate
   c. respiratory rate
   d. oxygen saturation
7. Oxygen via face mask
8. Give Epinephrine 0.3 ml of 1:1000 IM
9. Repeat q 5 minutes as needed
10. Start IV
11. If cardiac arrest:
    a. apply AED and follow instructions
    b. give Epi 10 ml of 1:10,000 IV
    c. begin CPR
12. Consider Benadryl 50mg or cimetidine 300mg IV
13. Transport to ER.

Case #2: High Spinal Block

The same patient as above presents to the pain physician for a medial branch block. This time, during performance of the procedure and shortly after injecting 0.5cc of 1% lidocaine, the patient reports a sensation of tingling throughout her body progressing quickly to numbness, weakness and difficulty breathing. She becomes very agitated and is gasping for air. Shortly thereafter, she loses consciousness. Following is the recommended protocol for high spinal block:[24]

1. Call for help:
   a. call code over intercom
   b. call 911
2. Have AED brought to room
3. Check airway:
   a. position patient supine
   b. open airway with head tilt-chin lift
   c. insert oral airway if apneic
4. Check for breathing:
   a. watch for chest rise, feel for breath, and listen for sound.
   b. if apneic, give 2 rescue breaths
5. Check circulation:
   a. check pulse
   b. if no pulse, start chest com pressions until AED arrives
   c. As soon as AED arrives attach and follow instructions.
6. Sit the patient upright if a lumbar injection was performed, otherwise place the patient in a reverse trendelenburg position. (Place OR table in head-up position)
7. Administer 100% Oxygen via mask.
8. Start IV-Bolus 1000cc normal saline, then run drip 200cc/hour.
9. Be prepared to assist patient with an ambu bag if patient is showing signs of poor respiratory effort, whispering, paradoxy/respirations, or anxiety.
10. If patient is snoring, insert nasal airway and assist patient with breathing.
11. If apneic: intubate with ET tube.
12. Check vital signs q 2 minutes:
    a. blood pressure
    b. heart rate
    c. respiratory rate
    d. oxygen saturation
13. If hypotensive: Ephedrine 5-10mg IV or 25-50mg IM or SC. 1ml=50mg (q 2-5min.).
14. If Bradycardic: Atropine 0.4mg IV. 1ml=0.4mg (q 5min.).
15. If no heart beat:
    a. apply AED and follow instructions
    b. administer 10ml of 1:10000 IV epinephrine slowly
    c. begin chest compressions
16. Transport to ER.

Case #3: Cardiac Chest Pain

A 67 year-old male presents with a complaint of neck pain and headaches that have become progressively worse over the past six months. He was diagnosed with cervical facet syndrome and had a successful medial branch block with greater than 80% relief on two occasions. He has a past medical history of coronary artery disease status post four-vessel bypass surgery 12 years ago. Recently he has been experiencing angina for which he takes nitrates and is followed by a cardiologist. He presented for a cervical medial branch RF procedure. During the procedure, he suddenly complained of crushing chest pain radiating into the left arm. Following is the recommended protocol for cardiac chest pain:[25]

1. Call for help:
   a. call code over intercom
   b. call 911
2. Have AED brought to room
3. Check airway:
   a. position patient supine
   b. open airway with head tilt-chin lift
   c. insert oral airway if apneic
4. Check for breathing:
   a. watch for chest rise, feel for

breath, and listen for sound.
   b. if apneic, give 2 rescue breaths
5. Check circulation:
   a. check pulse
   b. if no pulse, start chest compressions, until AED arrives
   c. As soon as AED arrives attach and follow instructions.
6. Check vital signs q 2 minutes:
   a. blood pressure
   b. heart rate
   c. respiratory rate
   d. oxygen saturation
7. Administer 100% Oxygen via mask.
8. Administer nitroglycerine if BP>100/60. Give 0.4mg sublingual q 5 minutes
9. Monitor for hypotension
10. Repeat administration of nitroglycerine two times
11. ASA 160-325mg po, chewed or suppository
12. Start IV
13. Administer morphine 2-4mg IV q 10 minutes if no pain relief from nitroglycerine administered three times.
14. Monitor for respiratory depression, hypotension, and lethargy.
15. Transport to ER.

Case #4: Cardiac Arrest

The patient's pain worsens and you note that he appears short of breath and cyanotic. You administer 0.4mg of sub-lingual nitroglycerine but, in your haste to treat the patient, you forget to obtain a blood pressure prior to administration of the nitroglycerine. Within a few minutes of administration, the patient cries out, "you're losing me, you're losing me!" He loses consciousness, stops breathing and you note there is no pulse. Following is the recommended protocol for cardiac arrest:

1. Check Responsiveness-Are you O.K.?

If Unresponsive:

2. Call for help:
   a. call code over intercom
   b. call 911
3. Have AED brought to room and attach to patient ASAP.
4. Check airway:
   a. position patient supine
   b. open airway with head tilt-chin lift
   c. insert oral airway if apneic
5. Check for breathing:
   a. watch for chest rise, feel for breath, and listen for sound.
   b. if apneic, give 2 rescue breaths
6. Check circulation:
   a. check pulse
   b. if no pulse, start chest compressions until AED arrives
   c. as soon as AED arrives attach and follow instructions
7. Ventilate with bag/mask—2 breaths every 30 compressions
8. Intubate
9. Start IV
10. Administer 6-10cc of 1:10,000 IV Epinephrine q 3-5 minutes for V-fib.
11. Administer 0.5mg of Atropine if heart rate<60bpm.
12. Check rhythm after 2 minutes of CPR and after every 2 minutes of CPR thereafter.
13. Transport to ER.

Case #5: Respiratory Arrest

Your patient presents for a lumbar medial branch radiofrequency procedure. The patient is positioned prone on the procedure table and the back is sterilely prepped and draped. The nurse anesthetist administers 100μg of fentanyl and 2.5mg of versed. Shortly after beginning the procedure, the patient becomes agitated and refuses to lie still. You administer an additional 2.5mg of versed and wait for the patient to calm down but the behavior worsens. The patient is now extremely agitated and you are unable to continue the procedure. The nurse anesthetist suggests propofol to chemically relax the patient. He administers 40mg of propofol and the patient becomes quite still but now she is not breathing. Following is the recommended protocol for respiratory arrest:[26]

1. Call for help:
   a. call code over intercom
   b. call 911
2. Have AED brought to room
3. Check responsiveness

If unresponsive:

4. Check airway:
   a. position patient supine
   b. open airway with head tilt-chin lift
   c. insert oral airway if apneic
5. Check for breathing:
   a. watch for chest rise, feel for breath, and listen for sound.
   b. if apneic, give 2 rescue breaths
6. Check circulation:
   a. check pulse
   b. if no pulse, start chest com pressions until AED arrives
7. Check vital signs every 2 minutes;
   a. check pulse
   b. BP
   c. Oxygen saturation
   d. Respiratory rate
      i. Insert oral airway
      ii. Ventilate with Ambu bag and 100% Oxygen
      iii. Start IV
8. As soon as AED arrives attach and follow instructions.
9. Intubate with ET tube
   a. Verify tube position:
      i. chest movements vs. abdominal distention
      ii. breath sounds vs. gastric gurgle
      iii. CO_2 monitor
   b. Continue to support ventilation until EMT arrive.
10. Transport to ER.

Note: Use of Narcan is not recommended in patients on daily doses of oral opiates. If the patient is not on daily opiates, then 1ml of 0.4mg/ml of narcan may be administered IV after step #9b.

Case #6: Seizure

A patient is referred for evaluation of a six-month history of lower extremity pain. The patient had previously undergone an ORIF for fixation of an ankle fracture. The pain after surgery has not resolved and, in fact, has worsened. He states he is not able to tolerate anything touching his foot and does not sleep with his leg under the blankets. The foot is cool, swollen, mottled and painful to touch. The patient wears a walking cast to protect the extremity and has not been able to work since the accident. The patient has a past history of grand mal seizures controlled with dilantin.

You decide to perform a lumbar sympathetic block for diagnosis of complex regional pain syndrome. During placement of the needle, you note blood in the hub of the needle that appears to be venous. Because the patient is allergic to contrast dyes, you decide to proceed without the use of contrast dye. After adjusting the position of the needle, you aspirate and there is no further evidence of blood return. A test dose of 1cc of 2% lidocaine is injected without complication. After waiting 30-60 seconds, you inject an additional 9cc's remaining in the

syringe. Because the patient is quite large, the needle is advanced to its full extent. Immediately after injecting the anesthetic the patient develops a seizure. The procedure is immediately aborted and the patient turned onto his side. The seizure stops but begins again after approximately sixty seconds. Following is the recommended protocol for seizure:[27]

1. Call for help:
   a. call code over intercom
   b. call 911
2. Bring AED to room
3. Check airway:
   a. position patient left lateral decubitus
   b. open airway with head tilt-chin lift
   c. remove dentures if present
   d. insert a nasopharyngeal airway if airway obstructed
4. Check breathing:
   a. check for breathing—look, listen, and feel
   b. turn on oxygen 100% via mask
   c. if not breathing, insert oral airway, give 2 rescue breaths
   d. ventilate w/ambu bag
   e. proceed to respiratory arrest protocol.
5. Check circulation:
   a. check pulse
   b. if a pulse is not present, go to cardiac arrest protocol
6. Administer Midazolam 5mg IM or 2.5mg IV q 5 minutes.
7. Start 20g IV
8. Attach cardiac monitor, pulse oximeter, and BP cuff
9. Monitor level of consciousness
10. Continue to monitor vital signs q 2 minutes.
11. Transport to ER. ■

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Dr. Rosenthal graduated from the University of Utah School of Medicine. He completed his internship in internal medicine at the University of Utah and his anesthesiology residency at the University of Texas Health Sciences Center in San Antonio, Texas. He is board-certified with the American Board of Anesthesiology, the American Board of Pain Medicine, the American Academy of Pain Management, and the American Society of Addiction Medicine. He is also qualified as a Fellow of Interventional Pain Physicians by the World Institute of Pain.

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