

**Steve Santangelo, MD Making Ultrasound-Assisted Continuous Regional  
Analgesia Practical In a Busy Practice**

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In a Busy Practice  
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Regional analgesia solutions have always been a compelling option, but limited by the experience of the anesthesiologists or surgeon. Since the introduction of ultrasound, there has been a surge of anesthesiologists interested in the benefits that ultrasound-guidance bring to the practice of regional analgesia. Blocks with ultrasound are faster to place, more reliable and longer in duration, but outcomes with single-shot blocks are not as impressive as one would expect. When continuous infusion catheters are used, outcomes as above show a clear benefit.

A number of series have emerged in the literature describing the use of continuous regional techniques and disposable elastomeric pumps for outpatient management of post-op pain control. With the use of ultrasound, catheter placement has become quick and reliable with consistent results and a near elimination of failures. Today, my aim is to present a description of techniques and methods that I have developed to make this process as smooth and efficient for the patients, their families, the surgeons, the hospital and ourselves.

The placement of a continuous regional catheter is considered to be an advanced technique. First, one must have a mastery in the use of ultrasound for single-shot blocks in the region that one intends to place the catheter. There are many practitioners in various stages of expertise. Some merely have the genuine interest and commitment to learn while others may have a comfort in several different types of ultrasound blocks with catheter experience. For those with developing skills, I recommend attending at least one course dedicated to ultrasound guided training that offers didactic and "hands-on" instruction in several types of blocks. I also recommend spending a lot of time with your machine even when you are not placing blocks. Your experience and confidence will accelerate when you image the neuroanatomy of you non-block patients. Bring your machine into the operating room and image as many patients and block locations as you can. It's easier to troubleshoot the machine and your own technique without an audience. There are practice gel blocks available with simulated nerves and vessels that help practice probe-needle coordination.

**First, do the groundwork.**

Once you decide to offer continuous regional analgesia to your patients, there are some questions you must answer: Which patients will I offer this technique? Which surgeons will I offer this technique? How will the hospital/department support my endeavor? How will the pharmacy support my endeavor? What additional equipment will I need?

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**The Patients and Families:** They must feel comfortable going home with the catheter and pump, following the simple care instructions, and removing the catheter. Better candidates are genuinely excited about this form of pain control when you describe it to them.

**Surgeons:** They also have to be enthusiastic. They have most to benefit from your effort. With a small investment in time (the time it takes you to place the catheter), their patient will be sent home with excellent pain control nearly free of side-effects and any related phone calls will be channeled away from them. In addition, their patient will return to them in follow-up raving about the catheter.

**The Hospital / Department:** They probably already purchased your ultrasound machine. Now they have to purchase the pumps. They will also have to track inventory, maintain a stock and incorporate a method of billing. They may also have available staff that can help educate the patients, families and nursing staff. This staff could also assist with the follow-up of the patients while at home. Data collection could be a bonus. Some institutions may require the pumps and a usage protocol approved by committee. Be sure to mention the cost-savings that results from the reduced hospital stay due to pain control.

**The Pharmacy:** They are an important ally in that they can fill the pumps using a sterile method and help eliminate drug and dosing errors. It takes time to fill the pump, and they will save your time by doing it for you while you are busy in the OR.

**Additional Equipment:** There are several types of outpatient pumps commercially available. When I select a pump, I keep the patient and family in mind. Simplicity and safety in design will prevent the patient and family from being intimidated by the device. I select a bulb elastomeric pump with a simple dial regulator that can be set and disabled to prevent accidental over/underdosing. Some pump types have a bolus feature to allow select patients to deliver an additional bolus dose for breakthrough situations.

**Second, get to work.**

Patients and families are an easy sell when you describe their regional options. Surgeons, however, can be more challenging. They come to the OR with prior experiences and knowledge of regional analgesia that are sometimes inaccurate. Sometimes, to be fair, their notions are spot-on. Placing a continuous regional catheter can take significantly longer than a single shot block and requires patience from your surgeon. But if you demonstrate a time-efficient style and show good results, you will soon gain their full support. Surgeons are also concerned about nerve injuries. Although the incidence of such injuries caused by block needles, catheters and possibly the local or additives, is exceedingly low, one bad experience can color the surgeon's impression of regional techniques for their entire career. There are no guaranteed antidotes for their impressions of the risks, but I will sometimes involve them in placing the block and point out the images on the ultrasound machine. Your care in needle placement will be evident to them.

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Set up the room with all of the sterile equipment open on a back table and the machine powered on and ready to go before the patient enters the room. As a Pediatric Anesthesiologist, I perform all blocks and catheter placement with the patient under a full general anesthetic. For some, this is a controversial issue. A recent statement from ASRA advises against general anesthesia or heavy sedation in cooperative adult patients who are having peripheral regional interventions. For children or others who do not have the cognitive skills to cooperate, unintended movement while performing a regional procedure could increase the risk of nerve injury.

I select an 18g, 10cm. Touhy needle and a 20g. fenestrated catheter for all continuous blocks. These items are in abundance in any OR. I try not to depend on equipment that leaves me unable perform the block if unavailable....except an ultrasound machine, of course.

Another contested issue is the use of nerve stimulation. I do not wish to use this time to discuss the merits of using nerve stimulation *versus* ultrasound. That is a choice of the Anesthesiologist. I prefer ultrasound because it allows me to place catheters faster with more reliable outcomes. What is at issue is the use of simultaneous ultrasound *with* nerve stimulation. As one begins to acquire ultrasound imaging skills, the greatest obstacle is the confidence to identify a structure with certainty. Nerve stimulation is useful in these early stages to confirm our interpretation of the images. Once these skills are mastered, the nerve stimulator adds no further information and only slows down the procedure. In fact, one study showed that there is a 13% false negative rate when nerve stimulation is used to confirm nerves seen on ultrasound. That is, the nerve was correctly identified on ultrasound, but the nerve stimulator failed to elicit a motor response when the needle was in proximity to the nerve, thus giving erroneous and dangerous information. While using the ultrasound, most use the nerve stimulator at a single amperage that would certainly elicit a twitch and then proceed with the block. Some will decrease the amperage as they would in a traditional nerve stimulated block. If one can clearly see the needle tip and the nerve, does decreasing the amperage give any more information about their proximity?

When placing a catheter, observe sterile technique. A sterile probe cover is warranted, but I cover the probe contact surface with a transparent adhesive dressing and wrap the cord in sterile plastic adhesive drapes. The advantage of this system is that the gel phase usually put between the probe and the inside of the probe cover is eliminated. Fewer solid phases through which the ultrasound signals must travel will improve the image quality. Also, I will place a sterile transparent drape over the ultrasound keyboard so I can make image adjustments without breaking the sterile field.

Yet another question that arises is whether to place the needle/catheter “in-plane” (needle and probe at 0 degrees) or “out-of-plane” (needle and probe at 90 degrees) with the screen image. While both methods are valid, I believe “in-plane” allows the operator to directly follow the entire path of the needle tip which ensures accuracy. Trainees also find this method much less frustrating to learn. The out-of-plane technique will place the entire needle apparatus in line with the nerve but the needle tip is not always visualized.

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The orientation of the catheter with respect to the nerve must also be chosen. The catheter can be placed perpendicular or parallel with the nerve. Assuming that the needle is in-plane, a **perpendicular** catheter will image the nerve in **cross-section**, while a **parallel** catheter will image the nerve **longitudinally**. It is satisfying to watch the catheter slide out of the needle on top of the nerve in parallel and leave several centimeters of catheter adjacent to the nerve surface. It would seem that it would provide better local spread to more nodes of Ranvier, and less likely to become dislodged. I usually place all catheters perpendicular to the nerve, however. I achieve the same clinical results and only one catheter has come dislodged. I chose this orientation because it is much simpler and faster to perform. Nerve structures are much less obvious in longitudinal views and the catheter tip can angle away from the nerve surface significantly as it is fed along the nerve.

A confirmation of catheter tip location is then performed. Although the tip of the catheter and the nerve can be visualized together in proximity, it is the local anesthetic, and not the catheter itself, that blocks the nerve. The simplest and most reliable method to confirm correct placement is to inject local via the catheter and visualize its real-time distribution around the nerve. I have placed catheters in what seems like good position but the local spreads more into the tissue space than around the nerve. With this method, the catheter will achieve the desired clinical result. Using contrast fluoroscopy or a stimulating catheter requires more specialized equipment and takes more time to perform.

Catheter fixation and dressing technique is vitally important. I tunnel all catheters. There seems to be a greater incidence of leak from the puncture site around the catheter without tunneling which compromises the integrity of the overlying adhesive dressing thus risking catheter dislodgment. Leaking catheters make patients anxious and create phone calls. Dermabond® is used to seal the original puncture site and adheres the external portion of the catheter firmly to the skin. The exothermic reaction of the Dermabond® in contact with air does not damage the catheter. Even with Dermabond®, patients are still able to remove the catheter easily. The tunneled catheter is dressed with Benzoin, skin tapes and a transparent adhesive dressing. Be careful not to cover the original puncture site with the dressing. If there is still some leakage, the fluid will not loosen the dressing. I have had some incidences of contact dermatitis when I have used Masticol instead of Benzoin.

**Local Dosing and Pump Setup:**

Ropivacaine 1% or 2% without additives is my preferred choice with hourly rates of 0.2-0.4 mg/kg/hour for pediatric patients. Ropivacaine 1% at a rate of 0.1-0.15 mg/kg/hour is chosen for adults. The pump has a maximum rate of 14 ml/hour. For young patients, I set a rate and disable the regulator so the rate cannot be changed. The fewer variables the patient and family have regarding the pump create less anxiety. I rarely have a patient with breakthrough pain despite their inability to adjust the rate. Motivated older patients and adults are allowed to adjust pump rates with my consultation either to increase the rate for a more dense block if desired or to reduce the

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rate to delay the exhaustion of the local reservoir. I do not use pumps with a bolus feature. Prior experience with this type of pump has created confusion with patients and families and early exhaustion of the local. The pump is attached to the catheter and placed in a “fanny pack”. The patient and family are instructed to leave the pack attached to the patient at all times. If not, the pump risks falling during patient transfer and could dislodge the catheter.

The patient is sent home with thorough, but simple, written instructions after all of the instructions are discussed.

**Follow-up:**

I provide the patient and family with a direct phone number or pager of a pain service practitioner that will respond immediately 24/7. They receive a phone call daily from a pain service practitioner to check on their progress, answer questions and provide reassurance. With the rate set, one can calculate when the pump will be emptied. The patient and family is instructed how to identify an empty pump and remove the catheter. A final follow-up phone call is made to the home to confirm that the catheter was removed in its entirety and the block has fully subsided. I provide the family my personal cell phone number to call anytime and I make the follow-up phone calls. This is a personal choice, and I have yet to have a family or patient call me first. They appreciate that they can reach me at any time and it quells anxieties knowing they can directly reach a human voice who knows them.

**Conclusion:**

Providing continuous regional analgesia, especially in an out-patient setting, is state-of-the art and requires specialized training and motivation. Ultrasound guidance makes its execution efficient with consistently excellent results. The methods I have described above were shaped over time to minimize OR time and maximize results and the satisfaction of all parties involved. Once mastered, the dividends are plentiful. Your patients and surgeons will agree.