CE

Joint Replacement and Rapid Mobilization

A Clinical Perspective on Rapid Arthroplasty Mobilization Protocol

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Rapid arthroplasty mobilization protocol (RAMP) is a multimodal approach that has been trialed and implemented over the past 9 years in an Australian hospital, on patients undergoing either a total hip or knee arthroplasty. The aim strongly focuses on improving patient outcomes, by alleviating many of the postoperative problems associated with total joint arthroplasty, such as pain control, early mobilization, nausea and vomiting, deep vein thrombosis, and increased length of hospital stay. In addition, RAMP is aimed at accelerating wellness to encourage a rapid return to optimum function within the individual. Key elements of this procedure are good communication and an understanding of the protocol by the patient, together with a clear understanding and knowledge of the postoperative care required by the orthopaedic nurses.

Major advancements in technology and research have offered patients with severe joint pain and debilitating joint function the ability to lead a more active life. The surgical procedure of total joint arthroplasty (TJA), where the diseased parts of the joint are replaced with implants, has become one of the most successful procedures in use today (Victorian Government Health Information, 2009). Total joint arthroplasty is recognized as an effective intervention that restores and improves limb function and alleviates the pain associated with musculoskeletal conditions (March et al., 2008). The effectiveness of TJA is attributed to the technological advances, skills of orthopaedic surgeons, and the combined efforts of the acute care teams. This article discusses rapid arthroplasty mobilization protocol (RAMP), the impact on patients' recovery following a total hip or knee arthroplasty with the use of RAMP, and the nursing role and responsibilities in ensuring a positive outcome with its implementation.

In Australia, more than 68,000 hip and knee joint arthroplasties are performed each year (Victorian Government Health Information, 2009), with a predicted increase as the population ages. In America, more than 1 million hip and knee joint arthroplasties were performed in 2006 (American Joint Replacement Registry, 2009), and this number is expected to exceed 4 million by the year 2030 (Paxton, Inacio, Slipchenko, & Fithian, 2008). The figure in Wales and the United Kingdom for total hip and knee joint arthroplasties performed annually is 160,000 (National Joint Registry, 2009).

The first total hip arthroplasty (THA) of the modern era was performed more than 50 years ago (Harris, 2009), and today it remains one of the most efficacious reconstructive procedures within orthopaedics (Huo, Stockton, Mont, & Parvizi, 2010). Extensive learning and progress about joint arthroplasty surgery have identified the need for promotion of faster rehabilitation and decreased length of hospital stay. This has created interest in identifying alternate methods of postoperative pain control, with the potential for decreasing the dependency of narcotics and their adverse effects. Postoperative pain control following TJA, such as epidural analgesia and peripheral nerve blocks, have provided excellent pain relief and reduced the consumption of narcotics but at the cost of other potential problems and associated side effects that are quite substantial (Vendittoli et al., 2006). New techniques and protocols are constantly being introduced, with the primary aim still strongly focusing on improving patient outcomes, particularly in the postoperative period where pain control and nausea and vomiting remain a significant problem in limiting early mobilization of the orthopaedic patient.

Rapid arthroplasty mobilization protocol is one such protocol that was trialed over the past 9 years by an Australian orthopaedic surgeon and an anesthetist on 1,098 patients undergoing either a THA or a total knee arthroplasty (TKA). Key elements in ensuring a positive outcome with the implementation of RAMP are good communication and an understanding of the protocol by the patient, combined with a clear understanding of the role and responsibilities of the nurses. The protocol is aimed at alleviating many of the postoperative issues associated with TJA such as pain, nausea and vomiting, and

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deep vein thrombosis (DVT). Alleviation of these issues allows for the rapid mobilization of the patient much earlier than would have been attempted. Rapid arthroplasty mobilization protocol aims to assist in the acceleration of a wellness attitude to encourage a rapid return to optimum function within the individual. Although decreasing the length of hospital stay is also a consideration, the surgeon takes a conservative approach to patient discharge, which is dependent on a number of factors such as age, frailty, living alone, and various social circumstances. The hospital length of stay varies from 4 to 12 days, with this time frame including patients who are transferred from the surgical ward to the rehabilitation unit.

The Pioneering of RAMP

Rapid arthroplasty mobilization protocol was originally based on the multimodal technique, local infiltration analgesia (LIA), designed by Drs. Kerr and Kohan. The RAMP surgeon had been extremely dissatisfied with his patient's postoperative pain management and the unpleasant side effects that stem from the use of narcotics. He felt that the LIA technique was worth trialing but with some modifications decided upon by the surgeon and the anesthetist (R. Brink, personal communication, May 2009).

Anecdotal evidence indicates that accelerated protocols similar to that of RAMP have been used for unicompartmental knee arthroplasty, TKA, and THA (Busch et al., 2006; Parvateneni et al., 2007; Vendittoli et al., 2006). Various combinations and drug dosages have been used by these authors in their multimodal approach, and all have demonstrated consistency with efficacy and safety. Kerr and Kohan (2008) in New South Wales, Australia, conducted a study using LIA on 325 patients having elective hip resurfacing, THA, and TKA between January 2005 and December 2006. Their multimodal technique was designed to control postoperative pain, avoid sedation, and enable early mobilization and discharge. They used opioid drugs either sparingly or not at all to assist with pain management. Their patients were satisfactorily mobilized within 5–6 hours postsurgery, and earlier discharge was achieved for most patients unless they had significant comorbidities.

What Is RAMP?

Rapid arthroplasty mobilization protocol is a multimodal approach used both intraoperatively and postoperatively on patients undergoing either a THA or a TKA. This technique combines a light general anesthetic, a spinal anesthetic, and the infiltration of a solution containing ropivacaine into the surgical field and subcutaneous tissues. An 18-gauge pain pump catheter and a suction drain are inserted into the intra-articular space (Stringer, Singhania, Sudhakar, & Brink, 2007). The pain pump catheter is then connected to a continuous pain infusion pump in situ. A reinfusion drain is sometimes used in place of a suction drain when indicated. There is no administration of narcotics intraoperatively, and no parenteral narcotics are ordered postoperatively. The patient experiences very little to no drowsiness postoperatively and generally returns to the ward in a completely alert state (R. Brink, personal communication). See Figures 1 and 2.

The development of multimodal techniques that include the administration of a local anesthetic, such as ropivacaine, through an intra-articular infusion device/catheter has become a well-recognized technique for orthopaedic postoperative pain control with rarely reported adverse effects (Webb & Ghosh, 2009). There have been noted discussion points by various authors questioning whether the use of intra-articular infusion devices provides a direct access for infectious agents. Stringer et al. (2007), following a study on 35 patients undergoing either a THA or a TKA, stated that there were no identified infections from the use of an intra-articular infusion catheter and this included a 2-year follow-up. The infusion catheters had been in situ for 48 hours prior to removal.

During the surgical procedure, the joint, ligaments, and exposed tissues are infiltrated with 250 mg of ropivacaine, 30 mg of ketorolac (added analgesic effect of an anti-inflammatory drug), and 0.5 mg of adrenaline (a vasoconstrictor added to delay absorption, prolong anesthesia, and slow the release of ropivacaine into the vascular system) in 108-ml solution administered in two distinct phases (Stringer et al. 2007). Upon closure of the wound, a further 250 mg of ropivacaine in 105-ml solution was infiltrated as a field block in the third phase. The infusion pain pump contains 300 mg of ropivacaine with 0.5 mg of adrenaline for THA patients and 1,000 mg of ropivacaine with 0.5 mg of adrenaline for TKA patients. Because THA is considered less painful than TKA postoperatively, a smaller dosage is administered (Stringer et al., 2007). Stringer et al. (2007) stated that on one occasion when a larger dose was administered to a patient following a THA, there was a temporary motor block of the sciatic nerve. To reduce the risk of reoccurrence, the smaller dosage was adopted. The pain pump is activated 12 hours after skin closure because the intraoperative wound infiltration provides excellent pain relief for up to 20 hours (Stringer et al., 2007). The infusion pump delivers 2.08 ml/hours of ropivacaine for 48 hours, providing effective pain control and allowing rapid mobilization of the patient. Once the infusion pump commences, the suction drain is unclamped for 10 min every hour until

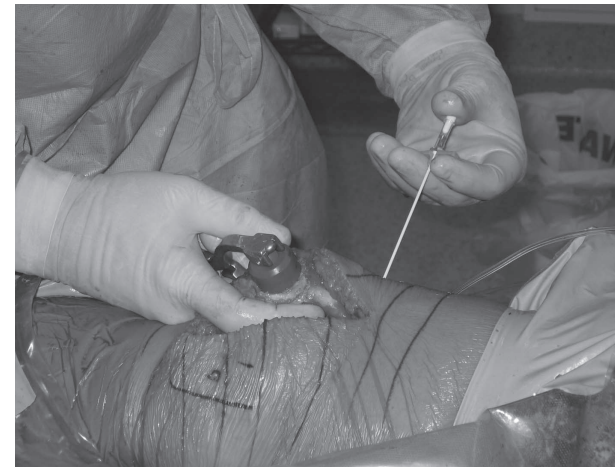

FIGURE 1. Insertion of a pain pump catheter following a total knee arthroplasty.

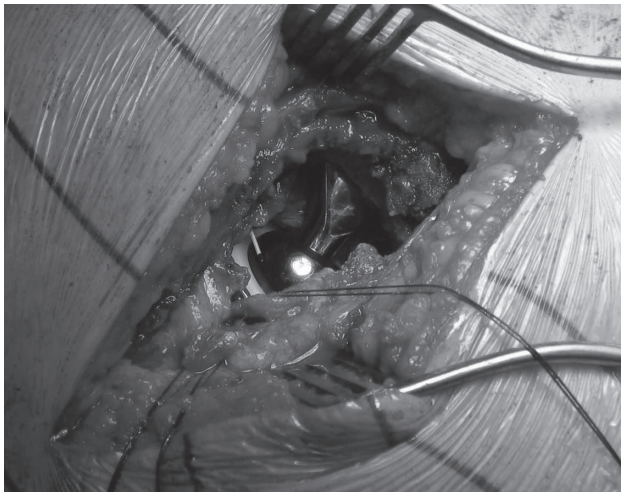

Figure 2. The visual tip of a pain pump catheter placed in the surgical site following a total hip arthroplasty.

drainage is minimal. The nurses do not find this procedure arduous because generally while the drain is unclamped, there is a 10-min window to continue with other duties. The suction drain is removed within 24–36 hours after the drainage becomes hemoserous (see Figure 3).

On the ward, pain management is continued with the use of a nonsteroidal anti-inflammatory drug, ibuprofen being the anesthetist's first choice, 400 mg four times a day, combined with 20 mg of omeprazole twice a day, and supplementary paracetamol (acetaminophen) 1,000 mg four times a day (Stringer et al., 2007).

With TKA, a tourniquet is generally not used by the surgeon, thus creating better oxygenation within blood flow, less chance of the development of a DVT, and lower volumes of ropivacaine surging through the circulation upon tourniquet release. With TKA, the surgeon also uses a compression bandage to the site that assists with prolonging the effect of the local anesthetic infusion and reduces swelling of the joint and operative site. Results published from a study to evaluate whether compression bandaging and LIA in TKA prolonged analgesic effects concluded that patients did in fact experience less pain and reduced swelling than those without the compression bandaging. Some mild discomfort was experienced on knee flexion because of the lack of elasticity of the bandage, but the authors concluded that the benefits of analgesia outweighed this mild discomfort (Anderson, Husted, Otte, Kristensen, & Kehlet, 2008).

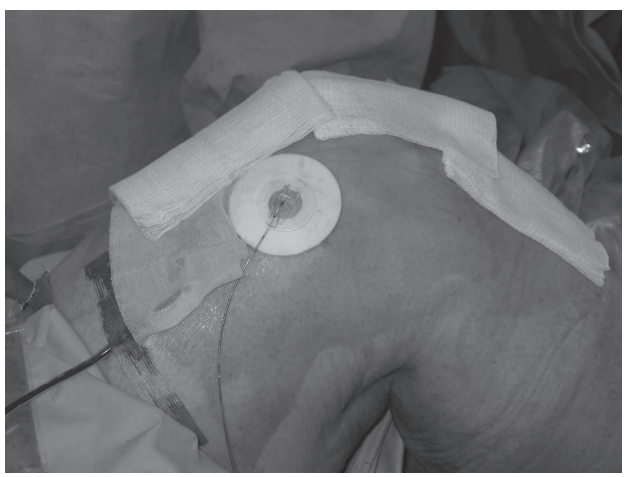

Figure 3. Patient with pain infusion pump in situ.

As RAMP signifies, patients are expected to ambulate much sooner with the use of this protocol. Patients having a TKA are able to ambulate within 2 hours postoperatively, and with a THA, patients are up and walking with the assistance of a pickup frame (walker) after just 4 hours.

Why Is Ropivacaine the Choice Local Anesthetic Used in RAMP?

A primary consideration with the multimodal protocol was to minimize risks of toxic side effects from the continuous infusion of a local anesthetic. Bupivacaine, commonly used as an anesthetic agent for its long duration of action, can cause central nervous system (CNS) symptoms such as tinnitus, dizziness, visual or speech disturbances, stiffness, twitching, and confusion or cardiac side effects that can be fatal (Halaszynski, 2010). Ropivacaine, an amide-type local anesthetic (Tiziani, 2010) known for its long-acting analgesic effects, has the same capacity as bupivacaine to produce differential blockade and based on clinical pharmacological studies has less risk of cardiotoxicity and less severity and frequency of CNS symptoms than bupivacaine. Ropivacaine has a shorter systemic half-life (ropivacaine has a half-life of 1.7 hours; Vendittoli et al., 2006) than bupivacaine, making it safer when used in repeated doses. It has been suggested that the use of local anesthetics for intra-articular analgesia, although providing effective, reliable, and safe postoperative pain relief, has demonstrated toxicity to articular chondrocytes. Piper and Kim (2008) identified that ropivacaine has a safer and significantly less chondrotoxic local anesthetic effect than the use of bupivacaine for postoperative pain relief.

During the trial of RAMP, venous blood samples were collected from 35 patients, 20 THA patients and 15 TKA patients, to determine the pharmacokinetic safety when using a continuous pain infusion pump containing ropivacaine. The nurses were required to take blood samples from a peripheral venous cannula located in the patient's antecubital vein over a 48-hours period. The first samples were collected before infiltration of ropivacaine, and the remainder of the samples collected during infusion. Samples were also taken from the wound drains (3 and 6 hours after skin closure) to determine the safety of reinfusing autologous blood within a postoperative 6-hours period if the patient had a reinfusion drain in situ. Stringer et al. (2007) identified that doses in the reinfusion drains were small and felt that any cumulative effect from these doses would have receded by the time the pain infusion pump commenced, approximately 6 hours after reinfusion (Stringer et al., 2007). This would also be dependent on the amount of blood that has drained within that time period to the actual concentration of reinfused ropivacaine. In the 15 TKA patients, the blood loss within the first 6 hours ranged from 58.8 to 1015 ml and in the THA patients, there was a blood loss

of 70–500 ml. The fact that autologous blood is infused slowly is considered to be an added safety factor, and when administered intravenously, ropivacaine has a half life of 14 ± 7 min. Stringer et al. (2007) stated that although there were strong indications that the reinfusion of the filtered autologous blood from the drains should be safe when administered during the first 6 hours postoperatively, because of the large doses of local anesthetic used in the wound infiltration, they suggested that further study be undertaken to determine safety. From the ropivacaine infiltration and pain pump infusion, there were no signs or symptoms of cardiac or CNS toxicity detected in any of the patients.

Nursing Implications: RAMP Versus Traditional Method

There are many aspects to consider with the postoperative care of a patient who has had a TJA. Pain and nausea and vomiting appear to be two major factors that affect the quality of life within the immediate postoperative period. The National Health and Medical Research Council (NHMRC, 2010) states that the prevalent attitude toward acute pain less than a generation ago was accepted as inevitable but was also suboptimally managed. Today, however, managing pain appropriately is understood to be a fundamental human right and a moral obligation by clinicians. Effective pain management is integral to patient-centered and cost-effective practice. Evidence continues to emerge that if severe acute pain is not relieved, adverse effects, both physiologically and psychologically, can occur.

Pain Control

Postoperative pain for TJA has traditionally been managed with the administration of drugs via the oral, intramuscular, and intravenous routes. Effective pain control methods should be able to block pain at its origin while maintaining maximum muscle control, allowing for postoperative mobilization and active physical therapy. Epidural analgesia, such as lumbar plexus, and femoral or sciatic nerve blocks are also effective ways to manage postoperative pain but can be technically demanding and carry a risk for other potential problems (Vendittoli et al., 2006). Side effects associated with these techniques are urinary retention, delayed mobilization, hypotension, nausea and vomiting, and diminished muscle control (Anderson, Pfeiffer-Jensen, Haraldsted, & Soballe, 2007). The use of patient-controlled analgesia (PCA) postoperatively allows the patient to self-administer analgesia prior to activities that may be associated with increased pain. This method has removed some of the barriers associated with administering analgesia in a timely manner but still encounters problems (Vendittoli et al., 2006). A patient's preoperative anxiety is an important psychological variable that can have a negative effect with the use of a PCA including increased demands and a degree of dissatisfaction with PCA pain management (NHMRC, 2010).

One major difference and a positive aspect for using RAMP with TJA are the alternative pain control methods it offers. Rapid arthroplasty mobilization protocol seems to have a positive impact on pain relief, not only allowing the comfort of a relatively pain-free postoperative period but also promoting the ability for early ambulation, rehabilitation, and discharge. Prior to discharge from the hospital, the patients' wounds must be dry without any signs of infection, their pain must be well controlled, and they must be physically and psychologically competent (R. Brink, personal communication).

Patients participating in RAMP return to the ward without IV therapy and are encouraged to eat and drink as soon as they feel up to it. This practice is encouraged to also assist with the prevention of hypotensive episodes. The majority of patients do not require the use of supplementary oxygen because they are completely alert and comfortably sitting up in bed.

Quite often following a THA, male patients, in particular, may experience urinary retention. If the patient has no success voiding postoperatively, he is then at risk for catheterization. This is an added complication that the patient can do without and one that tends to create anxiety and increase the risk for infection. With RAMP patients, voiding does not appear to be an issue. Because of early mobilization, they can use the toilet in a more normal and comfortable manner, thus avoiding urinary retention and catheterization.

The Risk for DVT

Deep vein thrombosis and subsequent pulmonary embolism (PE) are significant causes of postoperative morbidity and mortality. Orthopaedic patients are at high risk of developing a DVT, particularly following hip and knee surgery. Some contributing factors for the development of DVT include disarticulation of the femoral head during THA and application of a tourniquet to reduce blood loss during a TKA. Bone resection is a potent source of thromboplastins altering coagulation and impairing fibrinolysis (Turnbull, 2007). Turnbull (2007) states that characteristic of all postoperative patients is a fall in fibrinolytic activity beginning in the first 24 hours following surgery and reaching the lowest point on the third postoperative day. A surgical procedure requiring more than 30 min of general anesthesia is a leading risk factor for the development of DVT. Venous pooling in the lower extremities caused by the use of epidural and spinal anesthesia also places the patient at risk. Venous stasis has shown to be one of the primary factors in DVT formation and one of the most significant predisposing factors to venous stasis is immobility (Turnbull, 2007).

Prophylactic treatment is deemed necessary, if not mandatory, for the orthopaedic patient at risk for DVT. Because ambulation is not considered an adequate prophylactic measure alone, additional measures such as pharmacological agents, properly fitted graduated compression stockings, and intermittent pneumatic compression devices need to be used. Prophylaxis effectiveness in DVT management still remains a contentious issue, with limited agreement as to the most effective therapeutic combination (Turnbull, 2007).

Patients participating in RAMP do not require tourniquets applied intraoperatively for TKA for alleviating the effects of tourniquet pain and bruising. Patients are mobilized more rapidly than patients undergoing TJA

using the traditional method. They are all fitted for graduated elastic compression stockings prior to surgery and the efficacy of these stockings is well established in preventing DVT (Turnbull, 2007). Continuous passive motion machines are used postoperatively with RAMP patients to assist with movement and to improve flexion. The prophylactic daily administration of enoxaparin is also used for the inpatient to assist in the prevention of venous thromboembolism.

Now the question arises: "Does RAMP reduce thromboembolic disease in patients undergoing TKA and THA?" To date, there are no data available to confirm this for RAMP patients; however, looking at a study conducted by Pearce, Caldwell, Lockwood, and Hollard (2007) to determine whether early mobilization reduced the risk of postoperative venous thromboembolism provided some positive results. Of 97 post-TKA patients in an early mobilization group, 90 walked successfully within the first 24 hours following surgery. Ninety-eight patients formed a control group and began walking on their second postoperative day. Results in the control group for incidence of DVT fell 27.6%, with 1.0% in the early mobilization group. Further to this, the prophylactic regime used by Kerr and Kohan (2008) with the administration of 300 mg of aspirin daily to their patients routinely for a period of 6 weeks in combination with the enforced early mobilization resulted in extremely few thromboembolic events (Taylor & Francis, 2007). Since the commencement of RAMP in 2,000 of a total of 1,098 patients, there have been four radiologically confirmed DVTs and no PE (R. Brink, personal communication).

Postoperative Nausea and Vomiting

A frequent and clinically significant complication of surgery and general anesthesia is postoperative nausea and vomiting (PONV) often occurring in the immediate postoperative period with a reported incidence of up to 74% (Chang, Ho, & Sheen, 2010). A relationship exists between postoperative narcotic administrations, especially if patients are using the pain control method of PCA. The recorded incidence of PONV in these patients identified a 68%–100% increase (Roberts et al., 2005). Postoperative nausea and vomiting is often exacerbated in orthopaedic patients on intraoperative administration of morphine to assist in alleviating postoperative pain (Chang et al., 2010). Clinical pathways for TJA generally encourage patients to begin physical therapy on their first postoperative day, but with the unpleasant and distressing consequences of PONV this is often not the case. When patients experience severe bouts of nausea combined with pain, often this is a key element that can inhibit early ambulation.

Even though ambulation is rapid postsurgery, RAMP patients very rarely experience PONV. The surgeon and the anesthetist argued that this could be primarily due to the fact that RAMP patients were not administered narcotics intraoperatively or postoperatively and the type of anesthetic used may also have significance.

Nursing Care of RAMP Patients

Patients with intravenous fluids participating in RAMP do not return to the ward. Any autologous blood donated by the patient preoperatively is generally administered during the surgical procedure. An intravenous cannula remains in situ for 48 hours where it is flushed with 10 ml of normal saline twice a day to ensure patency for the administration of three times intravenous prophylactic antibiotics. The patient does not have a PCA or an epidural infusion, therefore, requiring the appropriate observations or dermatome levels as per the hospital's protocol. Postoperatively, RAMP patients are followed up half hourly for 2 hours, in 2 × 1 hourly sets, and if no abnormalities are identified, then 4 hourly. Neurovascular observations are half hourly for 4 hours, 4 hourly for 48 hours, and then twice a day for the duration of admission. As previously stated, RAMP patients with a suction drain and a pain infusion pump return to the ward.

Throughout the RAMP clinical trial and implementation, the orthopaedic surgeon, the relevant anesthetist, the physiotherapists, and the nurses involved all worked together as a dedicated team. The nurses have had to alter their way of caring for the orthopaedic patients involved with the study and implementation of RAMP, in combination with adjusting their time management on the ward. The clamping and releasing of the drain tubes on an hourly basis and ensuring that the RAMP patients are up and ambulating postsurgery at their specific allotted times have also required added adjustments.

There were some identified problems encountered with the monitoring of the function of the pain infusion pumps by the nurses. One of the infusion pumps was not commenced at the allocated time postoperatively, there were two faulty infusion pumps, and some infusion pumps appeared not be functioning properly, but the problem was identified as kinking of the tubing between the skin incision site and the infusion pump. The author upon consultation with the anesthetist developed an observation chart to ensure that correct procedure was being followed by the nurses along with identification and resolution of any associated problems.

Conclusion

Within today's healthcare system, the public continues to demand quality healthcare that focuses on quality patient outcomes. Through advances in the emergence of changing technology, procedures are continuing to expand and develop, encouraging patient empowerment in preparation for earlier discharge. The growing need to prepare patients for earlier discharge will increase with cost containment and managed care, all contributing to a reduction in hospital length of stay. Orthopaedic elective procedures often temporarily impair a person's ability for self-care, due to limited mobility and activity restrictions. There have been many efforts made to improve the postoperative recovery period, including optimization of pain management.

The process of RAMP has been designed to promote optimum function by the patient, by improving pain management postoperatively, promoting early ambulation, and with the added focus of empowering the patient to return to full independence as soon as practicable. RAMP facilitates numerous benefits for the patient. With excellent pain control, physiotherapy regimens are made much easier and more enjoyable. There is also a decreased risk

of DVT, PE, and chest infection. Urinary retention is less likely to occur. RAMP patients are discharged home earlier than those who have had a TJA using traditional methods.

Anecdotally, patients who have undergone RAMP expressed they could not praise the procedure highly enough especially if they had previously experienced a TJA with the traditional method. Moreover, not having to resort to the administration of narcotics for pain control was also a huge bonus for some of the patients, specifically if they had a history of severe nausea and vomiting with the use of morphine and pethidine (meperidine). Shorter length of hospital stay also appeared to be an added bonus for patients and families because they could resume their normal lives.

As the benefits and use of RAMP continue to be acknowledged and refined, other orthopaedic surgeons may use the multimodal protocol, allowing for optimization of pain control and eliminating many of the postoperative issues that prevent early mobilization and length of hospital stay. Not only would this be a positive step for the patient and their respective families but it would also be regarded as a productive move within healthcare organizations. Most important, for nurses, RAMP assists in the provision of quality nursing care to promote an excellent outcome.

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