This annotated bibliography includes a review of clinical studies that involve the ON-Q® PainBuster® and ON-Q C-bloc® ambulatory infusion pumps. It is an abridged list of available studies and readers are advised to review all relevant sources for complete information.

Selection Criteria for Included Studies:
- Published in peer reviewed journal, or presented at medical or scientific conference
- Prospective or retrospective comparison with controls; review paper (meta-analysis); or technique paper
- Published or presented in 2003 or later
- Includes use of ON-Q product (or “I-Flow elastomeric pump”) used for approved indications. No off-label use of the ON-Q Product is included.
- Selection criteria excludes any drug used in the study.

This bibliography includes a balance of positive, neutral and negative studies proportional to the number published in the literature. Clinicians are advised to refer to the product Directions for Use (DFU) for both the device used and medications prescribed for complete information regarding indication, contraindication, cautions and warnings.

There are inherent risks in all medical devices. Please refer to the product labeling for Indications, Cautions, Warnings and Contraindications. Failure to follow the product labeling could directly impact patient safety. Physician is responsible for prescribing and administering medications per instructions provided by the drug manufacturer. Refer to www.myON-Q.com for product safety Technical Bulletins.
1. **Postoperative Pain After Abdominal Hysterectomy: A Double-Blind Comparison Between Placebo And Local Anesthetic Infused Intraperitoneally.**

**AUTHOR**
Gupta A, et al

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled.

**INSTITUTION**
University Hospital, Orebro, Sweden

**NUMBER OF PATIENTS**
40

**SUMMARY**
Patients undergoing TAH were randomized to receive levobupivacaine 0.25% vs. saline via ON-Q pump with the catheter placed intraperitoneally. Results showed significantly less incisional and visceral pain in the first 2 hours (P < 0.05). Significantly less narcotic usage and post-op nausea was noted from hours 4 to 24 (P = 0.012) and total overall (P = 0.025). No significant differences were found in recovery times between groups, though there was a tendency toward earlier mobilization in the active group compared with placebo. Total and unbound levobupivacaine levels were small.

**ADVERSE EVENTS OR COMPLICATIONS**
No evidence of systemic infection. One patient in the placebo group had redness of the wound on day 1. Positive cultures were obtained from the catheter tips in two patients, one in each group, but these did not exhibit signs of clinical or laboratory evidence of infection in either.

**CONCLUSION**
Levobupivacaine used as an infusion intraperitoneally after elective abdominal hysterectomy has significant opioid-sparing effects.

2. **Reducing Pain and Costs with Innovative Postoperative Pain Management**

**AUTHOR**
Zimberg S

**REFERENCE**
*Managed Care Quarterly* 2003; 11(1):34-36

**STUDY DESIGN**
Review of two prospective studies.

**INSTITUTION**
Cleveland Clinic, Fort Lauderdale, FL

**NUMBER OF PATIENTS**
30 TAH and 130 colorectal

**SUMMARY**
This is a review of the challenges of managing postoperative pain, including the associated physiologic complications with narcotics, and the cost of care related to managing pain. The paper includes a discussion of two studies: the first study, on 30 TAH patients, showed a decrease in hospital costs of 30% in the study group compared to the control group, which was related to a decreased length of stay and reduced nursing interventions. These outcomes also led to greater patient safety and satisfaction. The second study on 130 colorectal surgery patients showed a 40% decrease in narcotics used by the study group compared to those that did not receive ON-Q. This resulted in return of bowel function one day earlier and a one-day decrease in hospital LOS.

**ADVERSE EVENTS AND COMPLICATIONS**
Not described.

**CONCLUSION**
Decreased costs of care and resource utilization, increased patient satisfaction, and higher quality of recovery make postoperative pain management with a continuous infusion device worthy of consideration.

3. **Postoperative Continuous Wound Irrigation versus Patient Controlled Epidural Analgesia (PCEA) Following Cesarean Delivery: A Randomized Study**

**AUTHOR**
Devroe S, et al

**REFERENCE**
Presented at Obstetric Anaesthesia meeting, Versaille 2004

**STUDY DESIGN**
Open prospective, randomized.

**INSTITUTION**
University Hospital Gasthuisberg, Leuven, Belgium
**NUMBER OF PATIENTS**

60

**SUMMARY**

Cesarean section patients, who all received patient-controlled epidural analgesia, were randomized to receive ropivacaine 0.2% at 5 ml/hr via subcutaneous wound infusion catheters versus saline placebo for 48 hrs post delivery. The ropivacaine group used significantly less epidural local anesthetic (420 +/- 77 vs. 157 +/- 53 ml) than the placebo group. Pain scores, maternal satisfaction and hospital stay were similar between the groups.

**ADVERSE EVENTS AND COMPILICATIONS**

Not described.

**CONCLUSION**

Continuous wound irrigation with ropivacaine 0.2% appears effective to manage post-cesarean section pain.

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**4. Postoperative Analgesic Effects of Continuous Wound Infiltration with Diclofenac after Elective Cesarean Delivery**

**AUTHOR**
Lavand’homme P, Roelants F, Waterloos H, DeKock MF

**REFERENCE**
Anesthesiology 2007; 106: 1220-5.

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled

**INSTITUTION**
Université Catholique de Louvain, Brussels

**NUMBER OF PATIENTS**

92

**SUMMARY**

Parturients were randomized to receive continuous intrawound infusion post C-section of diclofenac 300 mg, ropivacaine 0.2% or saline at 5 ml/hr for 48 hrs. Patients in the ropivacaine and saline groups also received diclofenac IV every 12 hrs for 48 hrs, and all groups had access to morphine PCA. Pain scores were significantly lower in both the ropivacaine and the diclofenac group at 12, 24 and 48 hrs post op. The diclofenac group consumed significantly less morphine compared to the saline group (P < 0.0009) at 12, 24 and 48 hrs without adverse effects. At 6 months postoperative, 3% of the diclofenac group, 10% of the ropivacaine group, and 23% of the saline group reported persistent pain at the scar. Time to return of bowel function and first oral intake was the similar between both groups. Hospital length of stay was the same in both groups.

**ADVERSE EVENTS AND COMPILATIONS**

No infection or delay in wound repair seen in either group.

**CONCLUSION**

After elective cesarean delivery, continuous intrawound infusion of diclofenac demonstrates a greater opioid-sparing effect and better postoperative analgesia than the same dose administered as an intermittent intravenous bolus.

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**5. Incisional and Epidural Analgesia after Caesarean Delivery: A Prospective, Placebo-Controlled, Randomized Clinical Study**

**AUTHOR**
Ranta P, Kukkonen J, Rawal N et al

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled.

**INSTITUTION**
Oulu University Hospital, Oulu, Finland

**NUMBER OF PATIENTS**

40

**SUMMARY**

Elective caesarean section patients were randomized to receive either levobupivacaine 0.125% at 10 ml/hr by epidural in intermittent doses with continuous saline infusion through a subfascial wound catheter, or saline epidural with levobupivacaine 0.25% 10 ml/hr in intermittent boluses through the wound catheter. The active epidural group had lower pain scores (1.8 vs. 3, P = 0.006) and lower consumption of local anesthetic (29 ml vs. 38 ml; P = 0.01) compared to the wound infusion group during the first four hours. After four hours, the pain scores were similar between the groups. Oxycodeone administration and patient satisfaction scores were similar between the two groups, though 50% of the wound infusion group considered their analgesia as poor, whereas only 2 in the epidural group rated their analgesia as poor.
ADVERSE EVENTS AND COMPLICATIONS
One patient in the epidural group and two in the subfascial group complained of mild nausea but did not require medication. One patient in the epidural group had motor weakness. No infections related to analgesia technique. Maximum venous plasma concentration of levobupivacaine was low and similar between the groups.

CONCLUSION
Incisional local analgesia administered via a subfascial catheter after caesarean delivery provided satisfactory analgesia without clinical side effects. This technique was easy to use, and patient satisfaction scores were comparable to that attained with epidural analgesia.

6. ON-Q Pump Infusion of Ropivacaine at the Incision for Pain Management after Gynecological Surgery

AUTHOR
Tyagaraj K, et al.

REFERENCE
Presented at ASA, Atlanta, GA. October 2005

STUDY DESIGN
Prospective, randomized, double blind, placebo-controlled

INSTITUTION
Maimonides Hospital, Brooklyn, NY

NUMBER OF PATIENTS
90

SUMMARY
Patients undergoing lower abdominal gynecologic surgery were randomized to receive ropivacaine 0.25%, 0.5% or saline by the ON-Q pump at 4 ml/hr. Results showed significantly lower VAS scores at rest at 6 hrs postoperative, and with coughing and leg raising at all time points for 48 hrs in the 0.5% group, but not in the 0.25% group, compared to the control group. There was slightly less morphine required by the 0.5% group compared to the other two groups but this was not statistically significant. There was no difference in ICU stay or hospital stay among the three groups.

ADVERSE EVENTS AND COMPLICATIONS
All catheter tips were cultured and showed no bacterial growth and no infections.

CONCLUSION
Patients receiving ON-Q pump infusion of 0.5% ropivacaine had significantly reduced severity of pain and vomiting than those who received saline placebo. This did not reduce the utilization of morphine. Use of ON-Q appears to be safe, since the catheters showed no signs of infection, and convenient, because of easy portability and high patient satisfaction.

7. The ON-Q Pain Pump for Pain Relief after Laparoscopic Surgery

AUTHOR
Dulemba JF, Medler-Petzel C.

REFERENCE
Presented at AAGL 35th Annual Meeting, Las Vegas, NV. November 2006

CONCLUSION
The insertion of the ON-Q pain pump decreases pain and results in less pain medication usage following laparoscopic surgery.

8. The Use of the ON-Q PainBuster for Postoperative Pain Management in Laparoscopic Assisted Vaginal Hysterectomy Patients

AUTHOR
Powers, Lynn
REFERENCE
Presented at Medical Education Foundation of the American College of Osteopathic Obstetricians and Gynecologists. Mar. 28 – April 1, 2007. Received MEFACOOG/Bayer Award for Excellence

STUDY DESIGN
Prospective observational study

INSTITUTION
Grandview/Southview Hospitals, Dayton, OH

NUMBER OF PATIENTS
20

SUMMARY
All patients received the ON-Q with bupivacaine 0.5% at 4 ml/hr for 3 days, with the catheters placed suprapubically with tips placed between the peritoneum and the vaginal mucosa in the vaginal vault. Nine patients were discharged home within 6 hrs of surgery, and 11 remained in the hospital < 24 hrs. All patients required minimal amount of narcotic analgesics and all patients reported adequate analgesia at home. No patients required antiemetic and all patients ambulated within 2 – 9 hrs after surgery.

ADVERSE EVENTS AND COMPLICATIONS
None

CONCLUSION
The results suggest that the ON-Q PainBuster is an acceptable method for adequate postoperative pain control in patients undergoing laparoscopic assisted vaginal hysterectomy.

9. Use of a Bupivacaine Continuous Wound Infusion System in Gynecologic Oncology: A Randomized Trial

AUTHOR
Kushner, DM, et al.

REFERENCE
Ob Gynecol 2005; 106 (2):227-33

STUDY DESIGN
Prospective, randomized, double-blind, placebo-controlled

INSTITUTION
University of Wisconsin Comprehensive Cancer Center, Madison, WI

NUMBER OF PATIENTS
80

SUMMARY
Patients undergoing laparotomy for suspected cancer were randomized to receive a continuous infusion of bupivacaine 0.5% or saline placebo at 2ml/hr for 72 hrs through soaker catheters placed in the deep subcutaneous space. There was no statistically significant difference in pain scores between the groups. There was no difference in the amount of narcotic or non-narcotic analgesia used by the two groups.

ADVERSE EVENTS AND COMPLICATIONS
Wound complications occurred in 20% of the treatment arm and 18% of the controls (8 wound events in the bupivacaine group and 7 in the control group.) These included cellulitis, superficial infection or hernia, and fascial disruption. Eight serious adverse events occurred in the placebo group including myocardial infarction, allergic reaction to chemotherapy, shortness of breath, nausea, 2 strokes and 2 pulmonary emboli, whereas, none occurred in the bupivacaine group. (P = 0.004).

CONCLUSION
The results of the current randomized trial do not support the use of the ON-Q bupivacaine infusion system for the management of postoperative pain in gynecologic oncology procedures. The large incisions and extensive dissections could potentially overwhelm the ability of the system to affect pain control, and its utility seems limited in this patient group.

10. Intraabdominal Local Anaesthetics for Postoperative Pain Relief Following Abdominal Hysterectomy: A Randomized, Double-Blind, Dose-Finding Study

AUTHOR(S)
Perniola A, et al.

REFERENCE

STUDY DESIGN
Prospective, randomized, double-blind

INSTITUTION
University Hospital, Orebro, Sweden

NUMBER OF PATIENTS
60

SUMMARY
Patients undergoing elective abdominal hysterectomy with or without salpingo-oopherectomy were randomized into three groups. All groups received levobupivacaine via ON-Q pump through a multihole
Postoperative Pain Management in Cesarean Section Patients

**AUTHOR**
Tiainen M, Syväoja S, Reinikainen M

**REFERENCE**

**STUDY DESIGN**
Retrospective review

**INSTITUTION**
North Karelia Central Hospital, Joensuu, Finland

**NUMBER OF PATIENTS**
30

**SUMMARY**
A retrospective review of cesarean section patients was done comparing 10 patients who received continuous wound infusion of local anesthetic (WILA) using the ON-Q PainBuster pump, 10 patients who had an epidural infusion of ropivacaine, and 10 patients who received oxycodone IM (traditional pain management) as needed for postoperative pain. All patients were able to receive oxycodone for unrelieved pain. In the ON-Q group, the catheter was placed in the surgical site over a closed fascia and the patients received ropivacaine 0.33% at 5 ml/hr plus additional 5 ml bolus of ropivacaine 0.75% available 3 times per day. The study showed that oxycodone requirements were 70% lower in the WILA group and 58% lower in the epidural group compared to the control group. Pain scores were significantly lower in the WILA and epidural group compared to the control group. Patient satisfaction scores were not different among the groups.

**ADVERSE EVENTS AND COMPLICATIONS**
No evidence for systemic or wound infections. No positive cultures for bacterial growth obtained from the catheter tips. The median total and free plasma concentration of levobupivacaine was about 50% of that reported to produce mild central nervous system symptoms in healthy volunteers.

**CONCLUSION**
Wound infusion of local anesthetic is as effective as epidural analgesia. Both wound infusion and epidural infusion significantly decreased the need for an opioid and improved the quality of pain management.
had significantly less nausea and required less antiemetic. \( P < 0.05 \).

**ADVERSE EVENTS AND COMPLICATIONS**
None

**CONCLUSION**
Subfacial levobupivacaine infusion with the ON-Q pain pump system diminished postoperative pain and the need for tramadol use following cesarean operations.

**NOTE**
Article in Turkish

13. **The Analgesia Efficacy of Ketorolac and Ropivacaine Infusion for Postoperative Pain Management**

**AUTHOR(S)**
Mcneil D, Muhammad R, Manchandani R, Pagala M, Tyagaraj K

**REFERENCE**
Presented at ASA 2008

**STUDY DESIGN**
Prospective, randomized, double-blind

**INSTITUTION**
Maimonides Medical Center, Brooklyn, NY

**NUMBER OF PATIENTS**
60

**SUMMARY**
Women undergoing open abdominal gynecologic procedures were randomized to receive an ON-Q pump with ketorolac (group 1) or ketorolac plus ropivacaine 0.5% (group 2) via an infusion catheter at the incision site. There were no significant differences in VAS pain scores and no significant difference in rescue analgesics between the 2 groups. There was also no difference in nausea, vomiting, drowsiness or patient satisfaction.

**ADVERSE EVENTS AND COMPLICATIONS**
None reported

**CONCLUSION**
Ketorolac alone is as efficacious as ketorolac plus ropivacaine in providing adequate pain relief. It is also ten times cheaper to administer ketorolac alone versus a combination of ropivacaine and ketorolac at this institution.

14. **Improving Continuous Wound Infusion Effectiveness for Postoperative Analgesia after Cesarean Delivery: A Randomized Controlled Trial**

**AUTHOR**
Rackelboom T, et al

**REFERENCE**
*Obstet Gynecol* 2010; 116(4):893-900

**STUDY DESIGN**
Prospective, randomized, double-blind

**INSTITUTION**
Cochin University Hospital, Paris, France

**NUMBER OF PATIENTS**
50

**SUMMARY**
Women undergoing elective cesarean delivery were randomized to receive a continuous infusion of ropivacaine 450 mg, ketoprofene 200 mg and saline 240 ml through a catheter placed either above or below the fascia and delivered by an elastomeric pump. The below fascia group had significantly reduced total morphine consumption, \((15.7 \text{ mg vs. } 26.4 \text{ mg}; P < 0.05)\), compared to the above fascia group. The VAS pain scores at rest were significantly lower in the below fascia group for 36 hours. There was no difference in pain scores with movement. Residual pain was assessed at one and six months and was not found to be different. MRI confirmed placement of catheters and showed saline to stay within the same plane as the catheter.

**ADVERSE EVENTS AND COMPLICATIONS**
There were no adverse events or systemic toxicity. Undesirable side effects (nausea, itching, and sedation) were the same in both groups. No wound infection or wound healing problems.

**CONCLUSION**
Local anesthetic combined with NSAID is more effective on postoperative pain control after cesarean delivery when administered below the fascia rather than above.
1. **Local Anesthetic Infusion Pumps Improve Postoperative Pain after Inguinal Hernia Repair: A Randomized Trial**

**AUTHOR**
Sanchez B, Waxman K, et al

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled.

**INSTITUTION**
Santa Barbara Cottage Hospital, Santa Barbara, CA

**NUMBER OF PATIENTS**
45

**SUMMARY**
Patients having open inguinal hernia repair were randomized to receive 0.25% bupivacaine at 2 ml/hr vs. saline via ON-Q pump for 48 hrs. Patients with ON-Q had significantly lower pain scores on postop day (POD) 2-5 (P < 0.05). There continued to be a difference in pain scores for 2 days after the catheter and pump were removed. There was no difference in the number of hydrocodone tablets used between the groups.

**ADVERSE EVENTS AND COMPLICATIONS**
There were no complications attributable to the infusion. No patients in either group developed a wound infection. One patient, in the bupivacaine group, had a postoperative hematoma, which resolved with non-operative observation.

**CONCLUSION**
Local anesthetic infusion pumps significantly decreased the amount of early postoperative pain. Pain relief persisted for 2 days after catheter and pump removal.

**ADVERSE EVENTS AND COMPLICATIONS**
No complications at the catheter or surgical site.

**CONCLUSION**
Continuous infusion of 0.5% bupivacaine at 2 ml/hr through the ON-Q pump is a safe and effective adjunct in postoperative pain management for open inguinal hernia repair.

2. **Evaluation of A Continuous Infusion Of 0.5% Marcaine via Elastomeric Pump for Postoperative Pain Management Following Open Inguinal Hernia Repair**

**AUTHOR**
LeBlanc K, et al

**REFERENCE**

**STUDY DESIGN**
Randomized, double blind, placebo controlled.

**INSTITUTION**
Surgical Specialty Group, Baton Rouge, LA

**NUMBER OF PATIENTS**
52

**SUMMARY**
Patients undergoing open inguinal hernia repair were randomized to receive bupivacaine 0.5% or saline at 0.2 ml/hr via the ON-Q pump for 48 hrs. Outcomes included VAS pain scores and narcotic use and were assessed for 120 hrs postoperatively. The results showed that 24% of the patients in the bupivacaine group used no narcotics, vs. 4% in the control group (P < 0.05). Daily and total narcotic usage was less in the bupivacaine group for 5 days. VAS pain scores were not significantly different between the groups.

3. **Patient Outcomes after Axillary Lymph Node Dissection for Breast Cancer: Use of Postoperative Continuous Local Anesthesia Infusion**

**AUTHOR**
Schell SR

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, double-blind (to drug, not to pump/no pump), placebo-controlled.

**INSTITUTION**
University of Florida

**NUMBER OF PATIENTS**
25

**SUMMARY**
Female patients undergoing modified radical mastectomy and axillary lymph node dissection (ALND) for breast cancer were randomized to standard pain management or standard pain management plus implantation of a continuous infusion catheter attached to the ON-Q pump with bupivacaine 0.5% or saline infusion at 0.5 ml/hr for 5 days. Patients in the bupivacaine group had significantly lower pain
scores during both morning and evening assessments (P < 0.001), used fewer daily doses of opioids (P < 0.001), and had significantly less nausea (P < 0.005) and sedation (P < 0.001) compared to patients with no pump or with saline placebo. Of note was that the study was prematurely unblinded and terminated due to the strength of the results.

ADVERSE EVENTS AND COMPLICATIONS
No pump related complications.
No wound complications including infection and seroma.

CONCLUSION
This study provides encouraging evidence of the therapeutic benefits of continuous infusion of local anesthesia and may represent a valuable adjunct for surgical patients who require ALND, including those with breast cancer and melanoma.

4. Short-term continuous local anesthesia delivery reduces long-term shoulder pain and disability following axillary lymph node dissection (ALND)

AUTHOR
Schell SR

REFERENCE

STUDY DESIGN
Randomized, blinded, placebo-controlled.

INSTITUTION
Cancer Institute of New Jersey, Robert Wood Johnson Medical School

NUMBER OF PATIENTS
25

SUMMARY
This presentation shared the late outcomes data for the study that was published and is listed above. (J Surg Res 2006; 134(1):124-32.) Patients that received ON-Q with bupivacaine 0.5% at 0.5 ml/hr after ALND surgery showed significantly less pain and improved shoulder function in 8 of 13 disability items on the Shoulder Pain and Disability Index (SPADI) scale after 2.4 years, when compared to patients who did not have the bupivacaine pain pump.

ADVERSE EVENTS AND COMPLICATIONS
No complications

CONCLUSION
Continuous administration of axillary local anesthesia results in significant improvements in SPADI scores following ALND for breast cancer. This long-term impact on function and morbidity represents an opportunity for significant impact upon a patient population with 8-73% risk of long-term complications following ALND for breast cancer.

5. Reduction or Elimination of Postoperative Pain Medication after Mastectomy Through the Use of a Temporarily Placed Local Anesthetic Pump vs. Control Group

AUTHOR
Morrison JE, Jacobs VR

REFERENCE
Zentralblatt fur Gymnologie. 2003; 125:17-22

STUDY DESIGN
Retrospective, comparative.

INSTITUTION
Fayette Hospital, Fayette, AL

NUMBER OF PATIENTS
49

SUMMARY
Forty-nine consecutive mastectomy patients were retrospectively reviewed, 22 of which were treated with the ON-Q with bupivacaine 0.25% at 4 ml/hr, and 27 who were treated without ON-Q. The number of patients who did not request any postoperative opioid was not significantly different overall. However, after day one, 68.2% of the ON-Q group did not require opioids vs. 11.1% of the control group (P < 0.001). The total dose of opioids [in morphine equivalents] was also significantly different and was reduced by 62.8% in the ON-Q group (P = 0.016) compared to controls. The ON-Q group also had shorter PACU time and hospital LOS, but these were not statistically significant.

ADVERSE EVENTS AND COMPLICATIONS
No signs of either local or systemic infections or toxicity.

CONCLUSION
Use of an ON-Q pain management pump could significantly reduce or even eliminate postoperative need for opioid analgesics.
6. Randomized Clinical Trial of Postoperative Subfascial Infusion with Bupivacaine Following Ambulatory Open Mesh Repair of Inguinal Hernia

**Author**
Lau H, Patil NG, Lee F

**Reference**

**Study Design**
Open prospective, randomized

**Institution**
Tung Wah Hospital, Hong Kong, China

**Number of Patients**
44

**Summary**
Patients undergoing open tension-free mesh hernioplasties were randomized to receive an infusion of bupivacaine 0.5% at 2 ml/hr through a catheter placed between the oblique aponeurosis and the Prolene* mesh, or standard pain management with oral analgesics alone. Postoperative pain scores were significantly lower in the pump group on days 0 and 1 postoperatively (P < 0.01). Recovery variables, i.e. time to micturation and ambulation, were comparable between the groups.

**Adverse Events and Complications**
25% of the patients reported seepage of blood-stained fluid into the wound dressing. Of these, one was due to a broken infusion catheter at the junction with the connector. The non-pump group had one infection, one wound bruising, one superficial wound dehiscence and one patient with urinary retention. The pump group had one patient with wound bruising but had no other complications.

**Conclusion**
Postoperative subfascial infusion of the wound with 0.5% bupivacaine achieved superior analgesia compared with oral analgesics alone. The portable infusion pump is a safe technique to continue local analgesia at home after ambulatory open repair of inguinal hernia.

7. A Prospective Comparison Of Continuous Wound Infiltration with Ropivacaine Versus Single-Injection Paravertebral Block after Modified Radical Mastectomy

**Author**
Sidiropoulou T, et al.

**Reference**
Anesth Analg 2008; 106:997-1001

**Study Design**
Prospective, randomized open-controls

**Institution**
University of Athens, Greece and Tor Vergata University, Rome, Italy

**Number of Patients**
48

**Summary**
Patients undergoing open unilateral modified radical mastectomy were randomly assigned to receive either a preoperative paravertebral block with 20 ml ropivacaine 0.5% (PVB) or placement of ON-Q dual catheters subcutaneously with continuous infusion of ropivacaine 0.5% (CRI) at 2 ml/hr each catheter for 24 hrs. Patients in the PVB group had lower VAS pain scores and less restricted movement in the shoulder for the first 4 hours, but subsequent pain scores and restricted movement in the shoulder were significantly lower in the CRI group. Narcotic use was the same in both groups. Patient satisfaction and morphine requirements did not differ between the groups.

**Conclusion**
Continuous wound infiltration of local anesthetics is an effective alternative to paravertebral analgesia after mastectomy with axillary lymph node dissection.

8. Wound Infusion with Local Anaesthesia after Laparotomy: A Randomized Controlled Trial

**Author**
Wang LW, et al

**Reference**
ANZ J Surg 2010; 80: 794-801

**Study Design**
Double-blind randomized, placebo controlled

**Number of Patients**
55

**Institution**
Prince of Wales Hospital, New South Wales, Australia
SUMMARY
Patients scheduled to undergo midline laparotomy were randomized to receive either ropivacaine 0.2% or saline via the ON-Q PainBuster pump through a catheter placed at the musculo-fascial closure. The ropivacaine group used significantly less PCA morphine in the 2nd 24 hrs (P = 0.02) and had a lower total mean PCA morphine consumption over the 48 hour study period (79 mg vs. 111 mg; P = 0.01). They also had an earlier time to first flatus and ambulation than the control group (P = 0.01, P = 0.02).

ADVERSE EVENTS AND COMPLICATIONS
Five patients developed SSI with no difference between groups (3 in control group; 2 in ropivacaine group). Significant reduction in ileus in ropivacaine group (P = 0.02). No CNS or cardiovascular system toxicity in any patients.

CONCLUSION
Local anesthesia infusion at the fascial plane provides effective analgesia. This improves patient recovery through earlier return to bowel function and mobilization.

9. **The Analgesic Efficacy of Continuous Wound Instillation with Ropivacaine after Open Hepatic Surgery**

AUTHOR
Chan SK, Lai PB, Wong J, Karmakar MK, Lee KF, Gin T

REFERENCE
*Anaesthesia* 2010: epub ahead of print

10. **Prospective Randomized Double-Blind Placebo-Controlled Trial of Postoperative Elastomeric Pain Pump Devices Used After Laparoscopic Ventral Hernia Repair**

AUTHOR
Rosen MJ, et al

REFERENCE
*Surg Endosc* 2009 Apr 9: epub ahead of print
ADVERSE EVENTS AND COMPLICATIONS
Postoperative complications occurred at the same rate in both groups. One mesh infection occurred in the active group but it was not attributed to the use of the pump. Seroma rate was equal in both groups. One patient had leakage at the catheter site after removal.

CONCLUSION
This study failed to show advantage of using an elastomeric pain pump device in terms of providing a measurable reduction in postoperative pain scores, narcotic use, time to return of bowel function or hospital length of stay.

11. Continuous Local Anesthetic Infusion for Pain Management after Outpatient Inguinal Herniorrhaphy

AUTHOR
Schurr MJ, Gordon DB, Pellino TA, Scanlon TA

REFERENCE

STUDY DESIGN
Prospective, randomized, blinded, placebo-controlled

INSTITUTION
University of Wisconsin Hospital, Madison, WI

NUMBER OF PATIENTS
79 (72 completed)

SUMMARY
Patients undergoing outpatient inguinal herniorrhaphy were randomized to receive continuous infusion of bupivacaine 0.5% or saline through catheters placed deep to the external oblique fascia and connected to an ON-Q pump to infuse at 2ml/hr for 60 hrs. Results showed lower worst and least pain scores on day one, and patients were able to ambulate more frequently when compared to the control group. On days 2 through 5, the differences were not significant.

ADVERSE EVENTS AND COMPLICATIONS
Two catheters had leakage in the PACU requiring catheters to be removed. One pump would not infuse, and one pump was inadvertently removed. Bupivacaine group reported less nausea on day one (P = 0.054). Fourteen patients had leakage around the catheter (19%). Three patients had post-operative wound infections (4%), one requiring surgical incision and drainage, but not mesh removal. Other complications occurred at the same rate in both groups.

CONCLUSION
The continuous infusion of local anesthetic after inguinal herniorrhaphy provides modest improvements in pain scores and functional outcomes compared to placebo. However, these effects are limited to first postoperative day only.

12. Continuous Transverse Abdominal Plane Block for Abdominal Surgery

AUTHOR
Ganapathy S, Tureanu B, Davies E, Quan D

REFERENCE
Presented at ASRA 2008

STUDY DESIGN
Case Reports

NUMBER OF PATIENTS
3

INSTITUTION
London Health Sciences Centre, University Hospital

SUMMARY
In three patients scheduled for revision of colostomy that had refused epidural anesthesia, four multifractal catheters were inserted into the transverse abdominis plane (TAP) under ultrasound guidance at the T10, mid-anterior axillary line and connected to two elastomeric pumps (ON-Q) for infusion of 0.35% ropivacaine at 2ml/hr per catheter and continued for 36-50 hrs. Following surgery, the average morphine consumption was 1 mg/hr for the first 24 hrs. PCA was discontinued on day 2 in 2 patients, and day 3 in 1 patient. Two patients had no nausea and one had minimal nausea.

ADVERSE EVENTS AND COMPLICATIONS
None reported

CONCLUSION
TAP block may be a useful alternative in abdominal surgery for patients who are not good candidates for epidural analgesia or refuse neuraxial catheter placement. It is a component of multimodal analgesia, and may be a good adjuvant for maintaining pain relief after removal of epidural, if narcotics are to be avoided.
13. **Use of the ON-Q Pain Management System Is Associated with Decreased Postoperative Analgesic Requirement: Double Blind Randomized Placebo Pilot Study**

**AUTHOR**
Baig MK, Zmora O, Derdemezi J, Weiss EG, Nogueras JJ, Wexner SD

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, placebo-controlled

**INSTITUTION**
Cleveland Clinic, Weston, FL

**NUMBER OF PATIENTS**
70

**SUMMARY**
Patients having midline laparotomy received bupivacaine 0.5% or saline via ON-Q pump for 72 hrs. The study group had earlier ambulation, significantly less narcotic usage and 50% less PCA attempts. There was no difference in postoperative pain scores or length of hospital stay between the two groups. The study group had earlier return of bowel function by one half day, but this was not statistically significant.

**ADVERSE EVENTS AND COMPLICATIONS**
There was no difference between the groups in the incidence of nausea or vomiting or other adverse events. There was one infection (2.9%) in each group within 7 postoperative days. This is significantly less than the reported rate from the CDC of 7.16% considered acceptable for this procedure.

**CONCLUSION**
This preliminary pilot study revealed that the ON-Q pain management system after midline laparotomy is an effective approach to postoperative pain control as part of a multimodal approach.
1. **Safety of 96-hour incision site continuous infusion of ropivacaine for postoperative analgesia after bowel cancer resection**

**AUTHOR**
Corso OH, Morris RG, Hewett PJ, Karatassa A.

**REFERENCE**
Ther Drug Monit 2007; 29:57-63.

**STUDY DESIGN**
Pilot observational study

**INSTITUTION**
The Queen Elizabeth Hospital, Woodville, SA, and University of Adelaide, SA. Australia

**NUMBER OF PATIENTS**
5

**SUMMARY**
This safety study measured plasma levels for total and unbound ropivacaine as well as α-1 acid glycoprotein (AAG) during and after a 96 hr infusion of ropivacaine 0.2% at 5 ml/hr after right hemicolectomy with catheters positioned between the internal and external oblique muscles. The results demonstrated that unbound plasma ropivacaine concentrations were well below published toxic thresholds. No signs of toxicity were observed in any patient. AAG was noted to rise after surgery, which binds to ropivacaine and makes it inactive. This study showed that measuring total ropivacaine levels alone can be misleading, since a rise in AAG provides a safety factor against toxicity. While pain scores were measured, they were not analyzed.

**ADVERSE EVENTS AND COMPLICATIONS**
One patient had leakage of ropivacaine from the catheter skin puncture site 20 hours into the infusion.

**CONCLUSION**
The data suggest the safety of using 0.2% ropivacaine infusion for 96 hours after bowel cancer resection for analgesia.

2. **Multicenter Infection Surveillance Study Comparing Two Types of Postoperative Pain Management, Surgical Site Using ON-Q® Silversoaker™ and Local Anesthetics vs. Systemic Narcotics Following Colorectal Procedures**

**AUTHOR**

**REFERENCE**

**STUDY DESIGN**
Prospective, multicenter, randomized, open, controlled surveillance study.

**INSTITUTION**
The Queen Elizabeth Hospital, Woodville, SA, and University of Adelaide, SA. Australia

**NUMBER OF PATIENTS**
289

**SUMMARY**
Following abdominal colorectal surgery, patients were randomized to receive either continuous surgical site infusion of local anesthetics via ON-Q PainBuster with ON-Q SilverSoaker (study group) or traditional pain management via PCA or epidural (control group) in order to compare SSI rates and hospital LOS. SSI was defined using CDC guidelines for surgical site infection which included surveillance up to 30 days postoperative. The incidence of SSI was found to be significantly less in the ON-Q group compared to controls (6.6% vs. 14.6%; P = 0.033) and LOS was significantly lower in the study group compared to the control group (6.1 days vs. 8.4 days; P = 0.0003).

**ADVERSE EVENTS AND COMPLICATIONS**
None reported

**CONCLUSION**
Continuous, surgical site, local anesthetic infusion via ON-Q PainBuster with ON-Q SilverSoaker appears to significantly reduce the risk of SSIs and length of stay in patients undergoing elective colorectal surgery.

3. **Continuous Preperitoneal Infusion of Ropivacaine Provides Effective Analgesia and Accelerates Recovery after Colorectal Surgery**

**AUTHOR**
Beaussier M, et al

**REFERENCE**
Anesthesiology 2007; 107(30); 461-8.

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled

**INSTITUTION**
St. Antoine Hospital, Paris, France
COLORECTAL SURGERY

NUMBER OF PATIENTS
49 (42 completed)

SUMMARY
Patients undergoing elective open colorectal surgery were randomized to receive either ropivacaine 0.2% or saline at 10 ml/hr via a multi-holed (Soaker) catheter placed in the preperitoneal space and delivered by the ON-Q PainBuster pump for 48 hrs postoperatively. Patients in the ropivacaine group had significantly lower pain scores at rest during the first 12 hrs, and with coughing for 48 hrs (P < 0.01). Significantly more morphine was required in the PACU by the control group (P = 0.004), and during the first 3 days postoperatively (P = 0.0004). Quality of sleep was rated higher in the active group and time to recovery of bowel activity was quicker (P < 0.02).

ADVERSE EVENTS AND COMPLICATIONS
No major complications. Two patients in the ropivacaine group and six in the control group experienced severe postoperative nausea and vomiting (P = NS).

CONCLUSION
Continuous preperitoneal administration of 0.2% ropivacaine at 10 ml/hr for 48 hrs after open colorectal resection reduced morphine consumption, improved pain relief, and accelerated postoperative recovery.

4. Parietal Analgesia Decreases Postoperative Diaphragm Dysfunction Induced By Abdominal Surgery

AUTHOR
Beaussier M, et al

REFERENCE

STUDY DESIGN
Open prospective, sequential sampling

INSTITUTIONS
St-Antoine Hospital, Paris, France; St. Vincent’s Medical Center, New York, NY; University of Montpelier, France

NUMBER OF PATIENTS
20

SUMMARY
Patients undergoing open colorectal surgery were enrolled sequentially into groups who received conventional parenteral postoperative analgesia (PCA), or conventional parenteral analgesia plus parietal analgesia using a continuous preperitoneal wound infusion (CPWI) with ropivacaine 0.2% infusing at 10 ml/hr for 48 hrs. Diaphragmatic function was assessed preoperatively and at 24 and 48 hrs postoperatively using the sniff nasal inspiratory pressure test (Psniff). The results showed a significantly greater reduction in postop Psniff readings in the control group compared to the CPWI group both at 24 hrs (P =0.001) and 48 hrs (P = 0.027).

ADVERSE EVENTS AND COMPLICATIONS
None described

CONCLUSION
Parietal analgesia delivered via a CPWI of ropivacaine reduces postoperative diaphragmatic dysfunction induced by open colorectal surgery.

5. Continuous Wound Infusion of Local Anesthetic for the Control for Pain after Elective Abdominal Colorectal Surgery

AUTHOR
Polglase AL, et al

REFERENCE
Dis Colon Rectum 2007; 00:1-10

STUDY DESIGN
Prospective, randomized, participant and outcome-assessor blinded, placebo controlled

INSTITUTION
Cabrini Hospital, Melbourne, Victoria, Australia

NUMBER OF PATIENTS
310

SUMMARY
Patients undergoing major abdominal colorectal surgery were randomized to receive ropivacaine 0.54% or saline at 4 ml/hr via dual catheters placed to the level of the fascia for 72 hrs. All patients had access to PCA with morphine with a background infusion of 1 mg/hr plus bolus doses of 1 mg available every 5 minutes. Mean morphine use and pain scores at rest were slightly lower in the ropivacaine group but the differences were not statistically significant. Hospital length of stay was the same in both groups.

ADVERSE EVENTS AND COMPLICATIONS
Adverse outcomes were similar in both groups.
CONCLUSION
Management of pain after major abdominal colorectal surgery is best achieved through adopting a multimodal approach to analgesia. Delivery of ropivacaine to midline laparotomy wounds via a PainBuster Soaker device is safe, but we have not demonstrated any significant clinical advantage over current best practice.
1. **Local Anesthetic Infiltration Increases Subcutaneous Tissue Oxygenation after Lower Abdominal Surgery**

**AUTHOR**
Ahmad M, et al.

**REFERENCE**
Presented at ASA, 2004, Las Vegas NV

**STUDY DESIGN**
Prospective, randomized, blinded, placebo-controlled.

**INSTITUTION**
Washington University, St. Louis, MO

**NUMBER OF PATIENTS**
45

**SUMMARY**
Patients undergoing radical prostatectomy were randomly assigned to receive bupivacaine 0.5%, ropivacaine 0.5%, or saline by wound infusion for 18-24 hrs. PsqO2 (subcutaneous oxygen pressure) was measured in the wound and in the upper arm during surgery, in recovery, and on the 1st post-op day. Results showed that bupivacaine increased the PsqO2 in the wound, most likely due to vasodilatation.

**ADVERSE EVENTS AND COMPLICATIONS**
None reported

**CONCLUSION**
The improved oxygenation of the wound may enhance wound healing and prevent postoperative infections.

2. **Reduction of Post Operative Surgical Discomfort after Robotic Radical Prostatectomy via the Use of the Non-Narcotic ON-Q Pain Relief System**

**AUTHOR**
Patel V

**REFERENCE**
Presented at the American College of Surgeons Annual Meeting 10/2004

**STUDY DESIGN**
Prospective, randomized study

**INSTITUTION**
Urology Centers of Alabama, Birmingham, AL

**NUMBER OF PATIENTS**
150

**SUMMARY**
Patients undergoing robotically-assisted laparoscopic radical prostatectomy were randomized to receive either morphine sulfate 4 mg IV every 3 hrs prn, or bupivacaine 0.5% at 4 ml/hr via subcutaneous ON-Q catheters placed to cover all trocar sites. All patients received ketorolac 30 mg IM every 6 hrs around the clock. Patients in the ON-Q group were discharged home with the pump and instructed to remove the catheters at 72 hrs. Postoperative pain was assessed using an American Pain Society Questionnaire on day one and at one week. The ON-Q group used significantly less morphine and hydrocodone compared to the control group, with 77% of the study group using no narcotics at all post surgery. They also had a one day earlier return of bowel activity and had lower pain scores on day one but not on day 7.

**ADVERSE EVENTS AND COMPLICATIONS**
No postoperative complications. No wound infections in either group.

**CONCLUSION**
Narcotic use can be minimized or completely eliminated by the use of a subcutaneously placed ON-Q pump after robotically assisted radical prostatectomy.

3. **Effectiveness of Continuous Wound Infusion Of 0.5% Ropivacaine by ON-Q Pain Relief System for Postoperative Pain Management after Open Nephrectomy**

**AUTHOR**
Forestiere E, Sofra M, Giannarelli L, Fabrizi L, Simone G.

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, double-blinded, placebo-controlled

**INSTITUTION**
Regina Elena National Cancer Institute, Rome, Italy

**NUMBER OF PATIENTS**
126

**SUMMARY**
Patients undergoing open nephrectomy were randomized to receive 0.5% ropivacaine or saline at 4 ml/hr via the ON-Q pump through two multi-holed catheters placed between the transverse and the internal oblique muscles and the subcutaneous space for 48 hrs for postoperative pain relief. Pain scores at rest and with coughing
were significantly lower in the ON-Q group at all time intervals (P < 0.0001-0.001). Mean morphine consumption was 47% lower in the ON-Q group (21.8 mg vs. 11.5 mg; P < 0.001). The ON-Q group had significantly lower scores for nausea and vomiting, lower sedation scores and earlier return of bowel function. The hospital length of stay was significantly less in the ON-Q group (2.1 days vs. 3.2 days; P < 0.001). Based on a projection of costs of care, the ON-Q group could have resulted in a net savings of ~273 € after costs for supplies.

ADVERSE EVENTS AND COMPLICATIONS
Side effects were similar (but not described) between the two groups.

CONCLUSION
Continuous surgical wound infusion with ropivacaine improved pain relief and accelerated recovery and discharge reducing overall costs of care.

4. **Efficacy of Continuous Local Anesthetic Infusion for Postoperative Pain after Radical Retropubic Prostatectomy**

**AUTHOR**
Wu CL, Partin AW, Rowlingson AJ, Kalish MA, Walsh PC, Fleisher LA

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled

**INSTITUTION**
Johns Hopkins University Hospital, Baltimore, MD and University of Pennsylvania, Philadelphia, PA.

**NUMBER OF PATIENTS**
100

**SUMMARY**
Patients undergoing elective radical retropubic prostatectomy were randomized to receive either a continuous infusion of bupivacaine 0.5% or saline at 2 ml/hr via a catheter placed subfascially in the incision for three days postoperatively. The results showed no statistically significant difference in VAS scores at rest or with activity, IV PCA narcotics, oral analgesics, or nausea scores between the groups.

**ADVERSE EVENTS AND COMPLICATIONS**
No catheter or pump related complications. No wound healing problems. No symptoms of local anesthetic toxicity.

**CONCLUSION**
The continuous infusion of local anesthetic after retropubic prostatectomy did not result in reduction in opioids or an improvement in pain scores. This may be related to the catheter placement position used for this study.

5. **Continuous Infusion of Local Anesthetic Decreases Narcotic Use and Length of Hospitalization after Laparoscopic Renal Surgery**

**AUTHOR**
Yoost TR, McIntyre M, Savage SJ

**REFERENCE**

**STUDY DESIGN**
Retrospective comparative

**NUMBER OF PATIENTS**
38

**INSTITUTION**
Medical University of South Carolina, Charleston, SC

**SUMMARY**
A retrospective review was conducted on 38 consecutive patients who had undergone either laparoscopic nephrectomy or laparoscopic nephroureterectomy to compare pain management using the ON-Q pump with bupivacaine 0.25% at 4ml/hr (N=18) to patients receiving traditional pain management with IV and oral analgesics (N=20). Results showed the mean narcotic use to be 25% less in the ON-Q group compared to the traditional pain management group (P = 0.1, NS), and the hospital length of stay to be significantly shorter (1.8 vs. 2.9 days; P = 0.01).

**ADVERSE EVENTS AND COMPLICATIONS**
There were no infections or wound healing problems in the ON-Q group.

**CONCLUSION**
A continuous infusion of 0.25% bupivacaine at 4 ml/hr through the ON-Q elastomeric infusion pump is safe and effective adjunct in postoperative pain management after laparoscopic renal surgery.
1. **Improved Pain Control after Cardiac Surgery: Results of a Randomized Double-Blind Clinical Trial**

**AUTHOR**
Dowling R, et al

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled

**INSTITUTION**
Jewish Hospital, Louisville, KY

**NUMBER OF PATIENTS**
35

**SUMMARY**
Patients undergoing elective coronary artery bypass surgery via a median sternotomy were randomized to have ON-Q catheters inserted into the sternal incision on top of the sternal wires connected to the ON-Q pump with either ropivacaine 0.2% or saline at 4 ml/hr for 48 hours. All patients also had IV PCA available for breakthrough pain. The ropivacaine group reported significantly less pain than the saline group as measured by VAS pain scores (1.6 vs. 2.6, P = 0.038), and used significantly less narcotic (45.3 ± 78.7 mg; P = 0.038). The ropivacaine group had a shorter hospital mean length of stay than the saline group (5.2 ± 1.3 days vs. 6.3 ± 2.8 days [after exclusion of one outlier in the placebo group] P < 0.01).

**ADVERSE EVENTS AND COMPLICATIONS**
No drug toxicity in either group. No difference in wound infections or wound healing. No complications related to placement of the catheters.

**CONCLUSION**
Continuous delivery of local anesthetics significantly improved postoperative pain control while decreasing the amount of narcotic analgesia required in patients who underwent median sternotomy. There was also a significant decrease in LOS which is likely to result in significant cost reductions.

2. **Use of Continuous Local Anesthetic Infusion for Pain Management after Median Sternotomy**

**AUTHOR**
White PF, et al

**REFERENCE**
Anesthesiology 2003; 99(4): 918-23

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled

**INSTITUTION**
UT Southwestern, Dallas, TX

**NUMBER OF PATIENTS**
36

**SUMMARY**
Patients undergoing median sternotomy for open-heart surgery were randomized to receive normal saline (control), bupivacaine 0.25% or bupivacaine 0.5% via ON-Q at 4 ml/hr x 48 hrs. Results showed that patients in the 0.5% group used significantly less narcotic by PCA (P < 0.05), had earlier removal of urinary catheter (P < 0.05), ambulated earlier (P < 0.05), and had shorter LOS (P < 0.05), compared to control or 0.25% group.

**ADVERSE EVENTS AND COMPLICATIONS**
Serum bupivacaine concentrations in all bupivacaine-treated patients were less than 4 μg/ml (considered to be the toxic threshold) at the end of 48 hr infusion period but were higher in the 0.5% group (1.3 ± 0.7) compared to the 0.25% group (0.5 ± 0.5) μg/ml. One catheter tip was inadvertently broken off during removal which required re-exploration under local anesthetic.

**CONCLUSION**
A continuous infusion of bupivacaine 0.5% at 4 ml/hr is effective for decreasing pain and the need for opioid analgesic medication as well as for improving patient satisfaction with pain management after cardiac surgery.

3. **Improved Pain Management Outcomes with Continuous Infusion of a Local Anesthetic after Thoracotomy**

**AUTHOR**
Wheatley GH, DiMaio JM

**REFERENCE**

**STUDY DESIGN**
Retrospective comparative

**INSTITUTION**
UT Southwestern, Dallas, TX

**NUMBER OF PATIENTS**
110

**SUMMARY**
Open, retrospective review of patients who had thoracotomy and were managed with either ON-Q
with bupivacaine 0.25% (N=38), continuous epidural (N=40), or single shot epidural plus ON-Q (N=32) for relief of postoperative pain. Results showed a significantly lower use of narcotics and improved pain scores in both ON-Q groups (P < 0.001).

ADVERSE EVENTS AND COMPLICATIONS
There were no infections or any wound healing complications in any patient receiving the ON-Q device.

CONCLUSION
A continuous infusion of 0.25% bupivacaine at 4 ml/hr through the ON-Q elastomeric infusion pump is a safe and effective adjunct in postoperative pain management after thoracotomy.

4. Efficacy of Methods of Intercostal Nerve Blockade for Pain Relief after Thoracotomy.

AUTHOR
Detterbeck FC

REFERENCE

INSTITUTION
Univ. of North Carolina, Chapel Hill, NC

STUDY DESIGN
Meta-analysis review paper

NUMBER OF PATIENTS
653 total in all studies reviewed related to extrapleural technique

SUMMARY
This paper describes and analyzes 4 techniques for providing pain relief after thoracotomy through meta-analysis of published prospective, randomized studies: Extrapleural infusion of local anesthetics (ON-Q described), interpleural administration of local anesthetics, cryoanalgesia, and direct intercostal nerve block. Only extrapleural infusion showed efficacy compared to narcotics or epidural analgesia.

ADVERSE EVENTS AND COMPLICATIONS
Local complications were seen in 0.6% of patients (2 out of 311); Systemic bupivacaine toxicity (confusion) was noted in 0.8% of patients (3 of 383). One patient experienced rib osteomyelitis as a result of the catheter. Toxicity to other local anesthetics has not been reported.

CONCLUSION
The data demonstrate that extrapleural analgesia is superior to systemic narcotics, and is at least as good as epidural, with fewer risks and side effects.

5. Subpleural Catheter Placement for Pain Relief after Thoracoscopic Resection

AUTHOR
Detterbeck FC

REFERENCE

INSTITUTION
Univ of North Carolina, Chapel Hill, NC

STUDY DESIGN
Technique review paper

SUMMARY
Describes the technique of placing an ON-Q Soaker catheter in the paravertebral extrapleural space to provide a multi-level intercostal nerve block for thoracoscopic lung resection. The author uses a DeBakey vascular clamp to tunnel the catheter to the destination.

ADVERSE EVENTS AND COMPLICATIONS
No complications have been noted with this insertion technique.

CONCLUSION
The technique of subpleural catheter placement is simple, rapid, and should be used more widely, particularly for patients undergoing thoracoscopic resection.

6. Randomized Controlled Phase III Trial of Paravertebral Catheter Vs Epidural Catheter for Post Thoracotomy Pain Control.

AUTHOR
Liptay MJ, et al.

REFERENCE

STUDY DESIGN
Prospective, randomized, open controls

INSTITUTION
Evanston Northwestern Healthcare, Evanston, IL and Indiana University, Indianapolis, IN

NUMBER OF PATIENTS
37
SUMMARY
Patients undergoing thoracotomy for lung resection were randomized to receive ON-Q by paravertebral block or thoracic epidural for postoperative pain management. Lower pain scores at 24 hours and 48 hours were reported in the paravertebral group (P = NS). There was no difference in narcotic usage or PCA attempts.

ADVERSE EVENTS AND COMPLICATIONS
No significant complications were noted associated with either catheter use.

CONCLUSION
Intraoperative ON-Q paravertebral catheter insertion provides comparable pain relief to the thoracic epidural catheter. Ease of insertion makes it an alternative to routine epidural insertion. Paravertebral catheter infusion post thoracotomy provided equal pain relief to thoracic epidurals making it an effective alternative.

7. Outcomes of Continuous Local Anesthetic Infusion at the Sternotomy for Pain Management

AUTHOR
Langley M, Husain A

REFERENCE
Presented at the American Association of Critical Care Nurses (AACN) National Teaching Institute, Atlanta, GA, May 2007.

STUDY DESIGN
Retrospective comparative

INSTITUTION
Cape Fear Valley Health System, Fayetteville, NC

SUMMARY
A chart review was conducted on adult patients after elective, uncomplicated cardiac surgery in which the study group received continuous infusion of bupivacaine 0.5% via dual catheters placed at the sternotomy site (n = 28), and the control group who received traditional pain management with no catheter placement (n = 18). While pain scores and analgesic requirements were similar on POD 1-3, the study group had significantly less pain and consumed fewer analgesics on day 4 (P = 0.04). Earlier extubation occurred for the catheter group than the control group (P = 0.008). There were no significant differences between groups in time to ambulation, return of bowel function, ICU or hospital LOS.

ADVERSE EVENTS AND COMPLICATIONS
None described

CONCLUSION
Continuous local anesthetic infusion at the sternotomy may reduce postoperative pain and analgesic requirements.

8. Use of Continuous Subcutaneous Anesthetic Infusion in Cardiac Surgical Patients after Median Sternotomy

AUTHOR
Koukis I, et al

REFERENCE
J Cardiothorac Surg 2008; 3:2

SUMMARY
Patients undergoing sternotomy for various cardiac surgical procedures had ON-Q dual catheters placed subcutaneously on sternal wires infusing ropivacaine 0.34% at 4 ml/hr for 4 days. Patients were observed for pain scores, opioid requirements and functional recovery and compared to standard parameters within the institution for similar patients. Results showed that ON-Q patients had less pain and used fewer opioids, with 75% of patients requiring no opioids at all. VAS scores were between 0 and 3 with a mean of 1.4. There was an earlier time to extubation and first bowel movement, and a shorter ICU and hospital LOS compared to the control group.

ADVERSE EVENTS AND COMPLICATIONS
No drug toxicity, wound infections or wound healing complications occurred in any of the patients. No complications related to placement or removal of the catheters, or pulmonary complications.

CONCLUSION
The continuous infusion of ropivacaine directly in the sternotomy incision significantly diminishes post-operative pain and the need for opioid analgesic use. It also seems to reduce overall postoperative length of stay.
9. **Chest-Tube Delivered Bupivacaine Improved Pain and Decreases Opioid Use after Thoracoscopy**

**AUTHOR**

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, non-blinded

**NUMBER OF PATIENTS**
30

**INSTITUTION**
Roswell Park Cancer Institute and State University of New York, Buffalo, NY

**SUMMARY**
Patients having non-rib spreading thoracoscopic procedures were randomized to 3 groups for postoperative pain management: group one received fentanyl via IV PCA (control group); group two received intermittent 30 ml bolus administration of bupivacaine every 6 hrs via a pleural infusion channel of a specially designed chest tube, plus fentanyl IV PCA; group three received a continuous infusion of bupivacaine 0.25% at 5 ml/hr using the ON-Q pump through the infusion port on the chest tube, plus fentanyl IV PCA. Visual analogue pain scores (VAPS) and fentanyl usage were compared. At 6 hrs, fentanyl requirements were less in both bupivacaine groups, though not statistically significant (P = 0.35, NS). At 24 hrs, adjusted (for early discharge) dosages of fentanyl were significantly less in the continuous bupivacaine group vs. control (P = 0.031). The fentanyl only group was not able to control pain at acceptable level at all points for all patients. The continuous group had lowest VAPS scores despite less fentanyl use.

**ADVERSE EVENTS AND COMPLICATIONS**
No study-related adverse events occurred.

**CONCLUSION**
Intermittent or continuous intra-pleural bupivacaine infused through the chest tube reliably reduces postoperative pain and 24-hr opioid usage in thoracoscopic patients.

10. **Comparison of the ON-Q PainBuster Post-Op Pain Relief System to a Thoracic Epidural for Control of Postoperative Thoracotomy Pain in A Child**

**AUTHOR**
Rampersad SE, Rowell JC, Chang BM

**REFERENCE**

**STUDY DESIGN**
Case presentation

**NUMBER OF PATIENTS**
1

**INSTITUTION**
Seattle Children’s Hospital, Seattle, WA and Capitol Anesthesiology Associates Group, Austin, TX

**SUMMARY**
An autistic, non-verbal six year old child who was undergoing a right thoracotomy received bupivacaine 0.25% at 2 ml/hr via a soaker catheter placed in the pericostal tissues delivered by the ON-Q pump because he was unable to receive epidural anesthesia due to pancytopenia. Less than 2 months later, the same child required a left thoracotomy and had a continuous epidural infusion of fentanyl and bupivacaine for post-operative pain management. Comparing the efficacy of pain management for these two episodes showed that the epidural provided slightly better pain relief in PACU, but, from the first night on, the pain relief and use of opioids was similar. The patient had a two day shorter length of stay with the ON-Q episode compared to the epidural.

**ADVERSE EVENTS AND COMPLICATIONS**
The epidural catheter had to be removed early due to leaking.

**CONCLUSION**
Placement of a soaker catheter for delivery of local anesthetic into the chest wound provides useful analgesia and opioid sparing effect following thoracoscopic surgery. This technique should be considered for those pediatric patients for whom a thoracic epidural is relatively or absolutely contraindicated.
1. **A Multi-Modal Approach To Pain Management Following Total Joint Replacement Surgery with the ON-Q Pain Relief System: A Prospective, Historical Control Study**

**AUTHOR**
Ford PJ, Salvagno RT, Pianta T, Dine A

**REFERENCE**

**STUDY DESIGN**
Prospective with retrospective controls

**INSTITUTION**
Center for Joint Replacement, Washington County Hospital, Hagerstown, MD

**NUMBER OF PATIENTS**
36

**SUMMARY**
Patients undergoing total hip (THR) or total knee (TKR) replacement surgery using ON-Q for pain management were compared retrospectively to similar patients having like procedures without ON-Q. Results showed significantly less narcotic usage and significantly less post-op nausea and vomiting. The researchers were able to eliminate the use of PCA following the initiation of the ON-Q for post-op pain management in this group.

**ADVERSE EVENTS AND COMPLICATIONS**
None reported

**CONCLUSION**
A comprehensive care program for THR and TKR patients, in combination with a multi-modal pain management system is a safe and effective method of improving postoperative pain management and improving outcomes in this population.

2. **Continuous Wound Infiltration with Ropivacaine Reduces Pain and Analgesic Requirements after Shoulder Surgery**

**AUTHOR**
Gottschalk A et al

**REFERENCE**
*Anesth Analg* 2003; 97:1086-91

**STUDY DESIGN**
Prospective, randomized, double-blinded, placebo-controlled

**INSTITUTION**
Department of Anesthesiology, University Hospital Eppendorf, Hamburg Germany

**NUMBER OF PATIENTS**
41

**SUMMARY**
Patients undergoing shoulder surgery were randomized to receive ropivacaine 2mg/ml, 3.75 mg/ml, or saline at 5 ml/hr via a subcutaneous soaker catheter and the ON-Q PainBuster pump. After surgery, VAS pain scores at rest and with mobilization, piritramide usage, and adverse effects were compared between the groups. The results showed significantly lower resting VAS pain scores in the 3.75 mg/ml group at all time points (P < 0.005), and the 2 mg/ml group at 4 hrs and 48 hrs postoperatively compared to the saline group. VAS scores during mobilization were also significantly lower in both ropivacaine groups compared to saline (P < 0.005 for both.) Piritramide consumption was significantly less in both ropivacaine groups compared to saline at 24 hrs (P < 0.005) and 48 hrs (P < 0.05).

**ADVERSE EVENTS AND COMPLICATIONS**
No patients had signs of motor block in the affected arm or shoulder. No infections or wound healing complications. No signs of local anesthetic toxicity detected. Plasma levels of unbound ropivacaine remained less than the toxic threshold of 0.6 μg/ml.

**CONCLUSION**
Continuous postoperative wound infiltration with ropivacaine, especially using 3.75 mg/ml, reduces pain and opioid requirements after shoulder surgery.

3. **Effect of a Local Anesthetic Infusion at the Surgical Site on Postoperative Pain and Recovery after Major Orthopedic Surgery Procedures**

**AUTHOR**
Coloma M, et al.

**REFERENCE**
Presented at ASA, October 2003

**STUDY DESIGN**
Randomized, prospective, double-blind

**INSTITUTION**
UT Southwestern, Dallas, TX

**NUMBER OF PATIENTS**
50

**SUMMARY**
Study of patients undergoing unilateral knee or hip replacement surgery randomized to receive bupivacaine 0.25%, 0.5% or
Results showed a decrease in PCA morphine usage in the bupivacaine 0.5% group. Pain scores and patients’ satisfaction scores were not significantly different between the three groups for up to one week after surgery.

ADVERSE EVENTS AND COMPLICATIONS
None reported

CONCLUSION
Infusion of bupivacaine 0.5% into the surgical site produced an opioid-sparing effect after major joint surgery. However, it failed to significantly reduce pain scores or facilitate recovery.

5. Periarticular Local Anesthetic Infusion with I-Flow Elastomeric Pump Provides Superb Analgesia, Reduces Opioid Use and Facilitates Early Ambulation

AUTHOR
Ganapathy S, et al.

REFERENCE
Presented at ASA October 2005, San Francisco, CA

STUDY DESIGN
Open prospective, placebo-controlled

INSTITUTION
St. Joseph Health Care, University of Western Ontario, Ontario, Canada

NUMBER
18 total hip arthroplasty (THA), 27 Total knee joint arthroplasty (TKJA)

SUMMARY
Patients having either TKJA or THA were randomized to receive ON-Q with ropivacaine 0.375% vs. saline via wound catheters for 72 hrs. TKJA patients received 3 catheters, one posterior at 5 ml/hr, and two anterior at 2 ml/hr each. THA patients received two catheters at 2 ml/hr each. Results showed significantly less narcotic requirement in TKJA group which extended to 7 days. There was less nausea and dizziness experienced in ON-Q group allowing easier ambulation. Hospital length of stay (LOS) was the same in both TKJA groups, but readiness to discharge was earlier in the ON-Q group. The THA data did not reach significance on any parameters.

ADVERSE EVENTS AND COMPLICATIONS
There were no infections, drug toxicity or deep vein thrombosis found in either active groups or controls.

CONCLUSION
Wound infusion of local anesthetic using I-Flow elastomeric pumps significantly reduced narcotic consumption following TKJA for 7 days postoperatively. This benefit was not seen with THA due to multiple incisions not being covered by the infusion catheters.
6. **Postoperative Continuous Paravertebral Anesthetic Infusion for Pain Control in Lumbar Spine Fusion Surgery**

**AUTHOR**
Elder JB, Hoh DJ, Wang MY

**REFERENCE**

**STUDY DESIGN**
Open prospective with retrospective case controls

**INSTITUTION**
University of Southern California, LA County Medical Center
Los Angeles, CA

**NUMBER OF PATIENTS**
52

**SUMMARY**
After posterior lumbar spinal fusion surgery, 26 consecutive patients received the ON-Q PainBuster with bupivacaine 0.5% at 4 ml/hr through dual catheters placed subfascially on either side of the incision. Pain scores and opioid use were recorded and compared to 26 case-controlled patients retrospectively. Patients with ON-Q used significantly less narcotics on days 1 – 3, and reported significantly lower pain scores on days 1 – 5. Patients with ON-Q had earlier discontinuation of PCA and earlier return of bowel function compared to the control group. No differences were observed in length of hospital stay or complication rates.

**ADVERSE EVENTS AND COMPlications**
Four catheters were removed prior to the 72 hour time point. Three patients in each group required repair of dural violation with intraoperative CSF leak. One member from each group required readmission due to wound infection. One patient in the ON-Q group fell out of bed on postoperative day 8, which was not felt to be related to the infusion device.

**CONCLUSION**
These results suggest that continuous infusion of local anesthetic into the wound during the immediate postoperative period is a safe and effective technique that results in lower pain scores and narcotic use.

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7. **The Efficacy of Continuous Bupivacaine Infiltration Following Arthroscopic Rotator Cuff Repair**

**AUTHOR**
Bannerjee SS, Pulido P, Adelson WS, Fronek J, Hoenecke HR

**REFERENCE**
Arthroscopy 2008; 24(4):397-402

**STUDY DESIGN**
Prospective, randomized, double-blind, placebo-controlled

**NUMBER OF PATIENTS**
60

**SUMMARY**
Patients undergoing arthroscopic rotator cuff repair surgery were randomized to receive 0.25% bupivacaine at 2 ml/hr or 5 ml/hr, or saline via the PainBuster infusion pump infusing through catheters placed in the subacromial space. The results showed no statistically significant difference in VAS pain scores (P = 0.45) or opioid use (P = 0.17) among the groups. The 2ml/hr group trended towards less pain and lower opioid requirement. The 5ml/hr group trended towards higher pain scores and opioid use.

**ADVERSE EVENTS AND COMPLICATIONS**
No complications occurred in any of the groups.

**CONCLUSION**
This study neither supports nor refutes the use of infusion pumps for postoperative pain after rotator cuff surgery.

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8. **Postoperative Continuous Paravertebral Anesthetic Infusion for Pain Control in Posterior Cervical Spine Surgery: A Case-Control Study**

**AUTHOR**
Elder JB, Hoh DJ, Liu CY, Wang MY

**REFERENCE**

**STUDY DESIGN**
Prospective consecutive with matched historical controls

**NUMBER OF PATIENTS**
50
ORTHOPEDIC/SPINE SURGERY

INSTITUTION
University of Southern California, Los Angeles, CA; University of Miami, Miami, FL

SUMMARY
Patients who underwent cervical spine fusion via the posterior midline approach received the ON-Q PainBuster pump postoperatively infusing bupivacaine 0.5% at 4 ml/hr via subfascial catheters for 72 hours. Patients also had access to PCA opioids postoperatively. Pain scores, opioid use, time to discontinuation of PCA and return of bowel function and ambulation were measured and compared with a matched historical control group. The results showed that the patients in the ON-Q group used 34.4% less narcotics (P = 0.02); had lower VAS pain scores on each postoperative day over four days (P < 0.05); had earlier return of bowel function (P = 0.031), ambulation (P = 0.03), and removal of PCA (P = 0.001); and had shorter mean hospital length of stay (4.9 vs. 6.7 days, P = 0.024) when compared to the control group.

ADVERSE EVENTS AND COMPLICATIONS
No immediate complications were attributable to the device. Three catheters were accidentally removed before 72 hours. One patient in the control group was readmitted to the hospital 10 days after discharge with cerebrospinal leak. One patient in the ON-Q group required surgical repair of a dural tear encountered during decompression. One patient in the control group required reoperation for a wound infection.

CONCLUSION
These results suggest that continuous infusion of local anesthetic into the paravertebral tissue during the immediate postoperative period is a safe and effective technique that achieves lower pain scores and narcotic use and improves multiple postoperative outcome variables.

9. A Prospective, Randomized, Double-Blind Study of the Efficacy of Postoperative Continuous Local Anesthetic Infusion at the Iliac Crest Bone Graft Site after Posterior Spinal Arthrodesis: A Minimum of 4-Year Follow Up

AUTHOR
Singh K, Phillips FM, Kuo E, Campbell M

REFERENCE

STUDY DESIGN
Surveillance follow-up to prospective, randomized, double-blind study

NUMBER OF PATIENTS
25

INSTITUTION
Rush University Hospital, Chicago, IL

SUMMARY
Patients were previously enrolled in randomized study following iliac crest harvest for spinal arthrodesis (ICBG) in which the study group had postoperative pain treated with a continuous infusion of local anesthetic or saline (controls) with the ON-Q pump. (Spine 2005; 30:2477-83). A subset of these patients was contacted by telephone at a minimum of four years after surgery (mean 4.7 years) to ascertain presence of residual or chronic pain at the operative site, need for opioid analgesia, and functional activity level. Results showed that patients in the study group reported significantly lower VAS pain scores than the control group (P < 0.05), had better functional activity levels (P = NS), and reported significantly fewer painful days per month (P < 0.05). Chronic graft site pain was reported in 7 out of 10 of the control group and in none of the study group. Patient satisfaction was significantly higher in the study group (P < 0.05).

ADVERSE EVENTS AND COMPLICATIONS
No acute or long term complications were attributable to the use of ON-Q.

CONCLUSION
It appears that the use of a catheter with a local anesthetic at the ICBG harvest site offers significantly improved subjective outcomes, satisfaction with the procedures, decreases narcotic requirement, and significantly reduces chronic dysesthesias at long-term follow up.

10. Comparing Periarticular ON-Q to Other Modes of Postoperative Analgesia for Total Knee Arthroplasty

AUTHOR
Ortiz SM, Logvinskiy E, Gupta P, Pagala M

REFERENCE
Presented at ASA, October 2008
STUDY DESIGN
Retrospective chart review

NUMBER OF PATIENTS
89

INSTITUTION
Maimonides Medical Center,
Brooklyn, NY

SUMMARY
A single-center retrospective chart review was done to compare various techniques for pain management after total knee replacement. The seven groups were: 1) Epidural; 2) PCA; 3) Scheduled opioids; 4) Continuous femoral infusion (CFI); 5) ON-Q periarticular infusion of bupivacaine 0.375%; 6) Combined ON-Q and Epidural; 7) Combined ON-Q and CFI. The group receiving epidural or PCA required significantly less opioids (8.56 mg vs. 4.75 mg) morphine equivalents respectively during the first 24 hrs compared to the ON-Q only group (P < 0.02). The ON-Q plus CFI group and the PCA group had significantly lower pain scores at rest at 48 hours compared to the ON-Q group (P < 0.05).

ADVERSE EVENTS AND COMPLICATIONS
Although statistically significant differences in complication rates were not reported, patients with ON-Q did demonstrate the potential for increased risk of local complications such as copious serosanguinous drainage, bleeding, and cellulitis at site of insertion.

CONCLUSION
This study demonstrated that ON-Q is not an effective mode of analgesia subsequent to total knee arthroplasty for postoperative pain management.
1. **Continuous Bupivacaine Wound Perfusion Following Immediate Tissue Expander Breast Reconstruction**

**AUTHOR**
Spann MD, et al

**REFERENCE**
Presented at Plastic Surgery Research Council 2004

**STUDY DESIGN**
Retrospective study

**INSTITUTION**
New York Presbyterian Hospital, New York, NY and New York Hospital Queens, New York, NY

**NUMBER OF PATIENTS**
23

**SUMMARY**
Patients who had unilateral or bilateral mastectomies with immediate tissue expander breast reconstruction were retrospectively reviewed in terms of pain management modality, length of hospital stay, parenteral narcotics analgesic requirements, and total narcotic and non-narcotic analgesic requirements. Patients who had bilateral mastectomy with tissue expander (ON-Q = 2; non-ON-Q = 9) did not show significant differences in any outcomes measured. In the unilateral group (ON-Q = 4; Non ON-Q = 8) there was a reduction in hospital days (1.3 vs. 2.6 days), decreased parenteral narcotic requirement (0.04 vs. 0.26 mg/kg/day) and total narcotic requirements (0.06 vs. 0.34 mg/kg/day, P < 0.05) in the ON-Q group compared to the control group.

**ADVERSE EVENTS AND COMPLICATIONS**
None reported

**CONCLUSION**
Postoperative continuous wound perfusion with bupivacaine 0.25% was effective in significantly decreasing total hospital days, and both parenteral and total narcotic requirements in the first 48 hours postoperatively in patients receiving immediate unilateral tissue expander reconstruction after mastectomy.

2. **Pain Management in Augmentation Mammaplasty: A Randomized, Comparative Study of the Use of a Continuous Infusion versus Self-Administration Intermittent Bolus of a Local Anesthetic.**

**AUTHOR**
Pacik PT

**REFERENCE**
Aesthetic Surg Journal 2004; 24:523-30

**STUDY DESIGN**
Prospective, randomized. Patients served as own controls

**INSTITUTION**
Outpatient Surgery Center, Manchester, NH

**NUMBER OF PATIENTS**
41

**SUMMARY**
Patients undergoing augmentation mammaplasty were given bupivacaine 0.25% with epinephrine via intermittent self-administration with an attached syringe to one breast, and continuous infusion of bupivacaine 0.25% via ON-Q to the other breast. The group was divided into one group that self administered 20 ml every 6 hours as needed, and the other was instructed to self-administer 10 ml every 4 hrs regardless of need. The results showed that patients preferred continuous infusion with ON-Q in both groups and had better pain relief with ON-Q in group two.

**ADVERSE EVENTS AND COMPLICATIONS**
No infections. One patient experienced unilateral implant deflation 7 weeks postoperatively (etiology unknown) and 2 hematomas required reoperation.

**CONCLUSION**
Both indwelling catheters using continuous flow and intermittent on-demand bolus anesthesia are effective in controlling postoperative pain.

3. **Decreased Narcotics Use with an Implantable Local Anesthetic Catheter after Deep Inferior Epigastric Perforator Flap Breast Reconstruction**

**AUTHOR**
Boehmler JH, Venturi ML, Nahabedian MY

**REFERENCE**

**STUDY DESIGN**
Open prospective with historical controls

**INSTITUTION**
Georgetown University Hospital, Washington DC

**NUMBER OF PATIENTS**
80
SUMMARY
Patients who were undergoing deep inferior epigastric perforator (DIEP) flap breast reconstruction who received a local anesthetic pain pump (ON-Q) with 270 ml of bupivacaine 0.25% infusing at 4 ml/hr through two catheters for pain management were compared to a retrospective cohort who did not receive the infusion. The patients in the ON-Q group had significantly less average narcotic used in the first 24 hrs (P = 0.04); the range of narcotics use (in morphine equivalents) was 6 to 111 mg in the control group and 0 to 70 mg in the study group. Total narcotic use was significantly less in study group (70.5 mg for controls, 54.9 mg for study; P = 0.03). There was no difference in use of antiemetic between the groups. There was no difference in hospital length of stay.

ADVERSE EVENTS AND COMPLICATIONS
No complications associated with the use of the implantable pain catheter.

CONCLUSION
The use of an implantable local anesthetic catheter placed in the abdomen can decrease narcotic use in the postoperative period after deep inferior epigastric perforator flap reconstruction.

REFERENCE

STUDY DESIGN
Retrospective review

NUMBER OF PATIENTS
38 with ON-Q, 35 without ON-Q

INSTITUTION
Christus St. Joseph Hospital, Houston, TX

SUMMARY
A retrospective study was done on abdominoplasty patients who had received either a pain pump or not for postoperative pain management. The pump group had catheters placed on the anterior rectus fascia and were connected to the ON-Q pump with bupivacaine 0.25% or 0.5% infusing at 4 ml/hr. Verbal pain scores, PCA narcotic usage, hospital stay and antiemetic treatment were compared between groups. There was no statistically significant difference in any of the measured parameters between groups, though hospital length of stay was trending toward significance showing a 0.3 days shorter LOS in the pump group (P = 0.09).

ADVERSE EVENTS AND COMPLICATIONS
None reported

CONCLUSION
In this study, the use of continuous infusion pain pumps did not significantly reduce postoperative pain in abdominoplasty patients. It is likely that technical aspects such as location and placement of the pain pump catheters and the routine placement of closed suction drains inferior to the catheters alter their function and efficacy in abdominoplasty patients.

5. Prospective, Randomized, Double‑Blind Trial of Local Anesthetic Infusion and Intravenous Narcotic Patient‑Controlled Anesthesia Pump for Pain Management after Free TRAM Flap Breast Reconstruction

AUTHOR
Heller L, Kowalski AM, Wei C, Butler CE

REFERENCE
Plast Reconstr Surg 2008; 122 (4):1010-18

STUDY DESIGN
Prospective, randomized, double-blind, placebo-controlled

NUMBER OF PATIENTS
23 in ON-Q group; 25 in placebo group

INSTITUTION
University of Texas M.D. Anderson Cancer Center

SUMMARY
Patients undergoing TRAM flap breast reconstruction were randomized to receive the ON-Q with bupivacaine 0.375% or normal saline at 4 ml/hr through two catheters placed at the donor site; one catheter was placed beneath the fascial closure within the closed rectus sheath, and the second catheter was placed subcutaneously along the superior aspect of the donor site. Pain scores, total narcotic usage, patient satisfaction, length of hospital stay and incidence of narcotic-related side effects were compared. The results showed the mean PCA narcotic use was 40% less on day one and 55% less on day two in ON-Q group compared to controls. (P = 0.019). The mean total narcotic use (PCA plus oral)
was 27% lower in ON-Q group compared to controls. (P = NS). There was no difference in LOS. More patients in the ON-Q group expressed complete satisfaction with pain control than the control group (P = 0.032).

ADVERSE EVENTS AND COMPLICATIONS
No technical problems or complications related to the equipment used. No adverse patient events.

CONCLUSION
The continuous infusion pump system appears to be as safe and effective method for postoperative donor-site pain management in TRAM flap breast reconstruction patients and should be considered for postoperative pain management.
1. **Continuous Peripheral Nerve Blockade for Inpatient and Outpatient Analgesia in Children**

**AUTHOR**
Ganesh A, et al

**REFERENCE**
Anesth Analg 2007; 105(5):1234-42

**STUDY DESIGN**
Retrospective review

**INSTITUTION**
Children’s Hospital of Philadelphia

**NUMBER OF PATIENTS**
226 catheters placed in 217 patients

**SUMMARY**
This study evaluated the feasibility of using continuous peripheral nerve blocks (CPNB) to provide postoperative analgesia for pediatric patients age 4 – 18 years undergoing orthopedic surgery. Patients received CPNB with infusions provided by either a CADD-Prizm PCS II Pump (N = 40) or ON-Q Pump (N = 163), and were evaluated for efficacy and complications of the therapy. The type of block, drug choice, and infusion rate were determined by the anesthesiologist. The results showed that 18% of patients did not use any opioids after surgery, and 49% required only PRN opioids, half of which were managed with oral opioids. 112 patients were discharged home with their infusions, 39 of them on the day of surgery. 99% of the catheters were successfully removed at home by a family member.

**ADVERSE EVENTS AND COMPICATIONS**
The overall failure rate was 15%, most attributed to catheter dislodgement. Motor blockade was observed in 24 patients (11%), most commonly after a sciatic nerve block. Sensory complications were noted in 6 patients (2.8%); 3 resolved spontaneously; 3 had prolonged numbness > 60 days, 2 femoral blocks and 1 infraclavicular block. One patient with femoral block developed superficial cellulitis which resolved with oral antibiotics. One infraclavicular catheter could not be removed by a family member and was successfully removed at clinic. One patient had tinnitus 36 hours after an infusion of bupivacaine 0.125% which resolved after termination of infusion.

**CONCLUSION**
The study demonstrated the feasibility of implementing a CPNB program to provide an alternative method of inpatient and outpatient postoperative analgesia after orthopedic surgery in children when appropriate expertise is available. Patient and family education along with frequent follow-up are crucial to detect and address adverse events promptly.

2. **Continuous Incisional Infusion of Local Anesthetic in Pediatric Patients Following Open Heart Surgery**

**AUTHOR**
Tirotta CF, et al

**REFERENCE**

**STUDY DESIGN**
Prospective, randomized, placebo-controlled, double-blind

**NUMBER OF PATIENTS**
72

**INSTITUTION**
Miami Children’s Hospital and Arnold Palmer Hospital for Children, Miami, FL

**SUMMARY**
Pediatric patients undergoing cardiac surgery received either local anesthetic (levobupivacaine 0.25% or bupivacaine 0.25%) or normal saline via an ON-Q catheter tunnelled lateral to the sternal incision in the subcutaneous tissue, and connected to the ON-Q pump to deliver < 0.4 mg/kg/hr of the study drug for 72 hours. Overall mean total morphine requirements were significantly lower in the treatment group days 1-3 (0.09 mg/kg vs. 0.5 mg/kg; P = 0.03). The morphine usage difference was also significant for the first 24 hrs (P = 0.007) but did not differ significantly on postoperative days two and three. When results were stratified by patient weight range, there was a reduced need for morphine in all groups except patients < 6.3 kg. There were 7 patients in the treatment group who required no morphine, vs. 1 in the control group (P = 0.02). Over 72 hours, the treatment group also received significantly less midazolam (0.4 mg/kg vs. 1.2 mg/kg; P = 0.002), less lorazepam (0.02 mg/kg vs. 0.05 mg/kg; P = 0.001) and less ketorolac (0.5 mg/kg vs. 0.9 mg/kg; P = 0.05) when compared to the placebo group. Time to first bowel movement was about 1 day earlier in the treatment group (P = 0.03). There was no difference in reported pain scores, LOS,
time to first oral intake and time of urinary catheter removal.

ADVERSE EVENTS AND COMPLICATIONS
There were no wound infections and no difference in wound healing between the groups. No patients experienced any signs or symptoms of local anesthetic toxicity. Plasma levels of local anesthetics remained below the toxic threshold (4 μg/ml) throughout the study period.

CONCLUSION
A continuous incisional infusion of local anesthetic reduced postoperative analgesic requirement and sedation use in pediatric patients undergoing a median sternotomy. Dosed at a maximum rate of 0.4 mg/kg/hr, this technique is effective and safe for up to 72 hrs, with plasma levels of local anesthetic well below the toxic threshold.

3. Effectiveness of an Anesthetic Continuous-Infusion Device in Children with Cerebral Palsy Undergoing Orthopaedic Surgery

AUTHOR
Muthusamy K, Chang FM, et al.

REFERENCE

STUDY DESIGN
Prospective, randomized, non-blinded (pump vs. no pump)

NUMBER OF PATIENTS
54

INSTITUTION
Orthopaedic Trauma Unit, Aberdeen Royal Infirmary, Aberdeen, UK; and The Children’s Hospital Denver, Aurora, CO

SUMMARY
Ambulatory surgery pediatric patients aged 3 to 18 years with diagnosis of cerebral palsy (CP) who were undergoing outpatient hardware removal, tendo-achilles lengthening, or Strayer’s intramuscular gastrocnemius lengthening were randomized to receive bupivacaine 0.2 mg/kg/hr via the ON-Q pump plus oral analgesics x 48 hrs vs. standard oral analgesic medication alone for postoperative pain. The results showed that the level of pain severity (reported by parent) was significantly higher in the control group overall (P < 0.0001) and on days 1 and 2 postoperatively (P < 0.0003 and 0.024). There was no difference in pain severity on day 3. VAS scores for pain at rest and with movement were significantly higher in the control group (P = 0.042 and 0.029). Mean and total analgesic medication delivered was consistently higher in the control group but was not statistically significant.

ADVERSE EVENTS AND COMPLICATIONS
No adverse events reported

CONCLUSION
The pain pump is an effective pain management technique that significantly reduces pain intensity in children with CP after lower extremity orthopaedic procedures.

4. Continuous Infusion of Bupivacaine Reduces Postoperative Morphine Use in Adolescent Idiopathic Scoliosis after Posterior Spine Fusion

AUTHOR
Ross PA, Smith BM, Tolo VT, Khemani RG

REFERENCE
Spine 2010; epub ahead of print

STUDY DESIGN
Retrospective review

NUMBER OF PATIENTS
244

INSTITUTION
Children’s Hospital of Los Angeles, University of Southern California Keck School of Medicine

SUMMARY
A retrospective review was conducted on adolescent patients age 10 -18 years of age who had undergone posterior spinal fusion for idiopathic scoliosis. The objective was to assess the efficacy of pain management comparing a continuous infusion of bupivacaine 0.5% x 4 ml/hr via the ON-Q pump to patients who had traditional pain management with opioids (controls). Infusion catheters were placed at the level of the implant, within the muscle, subfascial or subcutaneous, per surgeon preference. The results showed that significantly fewer patients in the bupivacaine group needed a basal infusion of morphine (32.6% vs. 85.2%; P < 0.001), and median total ICU opioid use during first postoperative day was significantly less (18.9 mg vs. 26.4 mg; P < 0.001) when compared to controls. Pain scores were low in both groups, and there was no
significant difference in pain scores between the groups. Fewer patients in the bupivacaine group required antiemetic medications (70.5% vs. 85.2%; P < 0.001). A comparison between catheter placement groups was also conducted and found no difference in pain scores or morphine usage by depth of catheter placement.

ADVERSE EVENTS AND COMPlications
No complications described

CONCLUSION
This study demonstrates the use of a continuous infusion of bupivacaine results in good analgesia with low pain scores with diminished need for continuous opioids.
1. Predictors of wound infection following laparoscopic roux-en-Y gastric bypass.

**AUTHOR**
Dao T, Fisher T, Arnold D, Barnes G, McCarty T

**REFERENCE**
Presented at North Texas American College of Surgeons meeting. February 2006

**STUDY DESIGN**
Prospective database review.

**INSTITUTION**
Baylor University Medical Center, Dallas, TX

**NUMBER OF PATIENTS**
2072

**SUMMARY**
Database was queried to determine variables that affect infection rate in patients who had laparoscopic Roux-en-Y gastric bypass. Of the total, 1064 had ON-Q, 1008 did not have ON-Q. The study showed identical infection rates (0.9%) for both groups.

**ADVERSE EVENTS AND COMPLICATIONS**
None reported

**CONCLUSION**
Of the other factors considered, only the presence of diabetes mellitus was an independent variable that predicted infection.

2. Use of Local Anesthetic Infusion Catheter in Laparoscopic Roux-En-Y Gastric Bypass Patients

**AUTHOR**
Hilliard SM, McCarty TM, et al

**REFERENCE**
Presented at Southwest Surgical Congress, San Antonio, TX, April 2005

**STUDY DESIGN**
Retrospective review

**INSTITUTION**
Baylor University Medical Center, Dallas, TX

**NUMBER OF PATIENTS**
200

**SUMMARY**
A retrospective chart review compared 100 patients who underwent laparoscopic Roux-en-Y gastric bypass surgery who had local anesthetic infusion into the left subcostal trocar site to 100 consecutive patients who underwent the same procedure without an infusion catheter. Results showed a statistically significant decrease in narcotic requirements in the study group (63.89 vs. 116.14 morphine equivalents; P < 0.05). There was also a statistically significant improvement in the number of patients discharged within 23 hours for the infusion catheter patients compared to the patients without the infusion catheter (87% vs. 80%; P < 0.05).

**ADVERSE EVENTS AND COMPLICATIONS**
There were two study group patients who had wound erythema requiring antibiotics, compared to three infections in control group, two of which required incision and drainage.

**CONCLUSION**
The addition of a local anesthetic infusion catheter has proven to be a useful adjunct to help gastric bypass patients reduce their narcotic pain medication requirements and to allow an earlier discharge as an outpatient procedure, without increasing their overall risk for complications.

3. A Randomized Trial of Bupivacaine Pain Pumps to Eliminate the Need for Patient Controlled Analgesia Pumps in Primary Laparoscopic Roux-en-Y Gastric Bypass

**AUTHOR**
Cottam, DR, et al.

**REFERENCE**
Obesity Surgery 2007; 17: 595-600

**STUDY DESIGN**
Prospective, randomized, open controls

**NUMBER OF PATIENTS**
40

**SUMMARY**
Patients undergoing laparoscopic Roux-en-Y gastric bypass (LRYGBP) were randomized to receive either a standard pain management protocol with PCA meperidine and oral opioid analgesics, or placement of two ON-Q catheters sub-xyphoid radiating subcostally in the subfascial plane. These catheters were connected to the ON-Q pain pump with bupivacaine 0.5% infusing at 4 ml/hr. There was a significantly lower use of opioids (in meperidine equivalents) by PCA from PACU to 06:00 hrs the next morning in the ON-Q group compared to controls (217 mg vs. 129 mg; P = 0.008). There
was no difference in pain scores, nausea scores, gas pain, or use of antiemetic between the groups.

ADVERSE EVENTS AND COMPLICATIONS
None reported

CONCLUSION
The use of the ON-Q pain pump dramatically reduces the use of postoperative opioid analgesics from discharge in the PACU to the first postoperative morning at 06:00 hrs. Use of the ON-Q pain pump accomplishes this postoperatively without compromising pain scores and without the use of a PCA pump.

4. Gastric Bypass and ON-Q Pump: Effectiveness of Soaker Catheter System on Recovery of Bariatric Patients

AUTHOR
Iyer CP, et al

REFERENCE

STUDY DESIGN
Prospective, randomized, double-blind, placebo-controlled

NUMBER OF PATIENTS
45

INSTITUTION
Veteran Affairs Medical Center, Dallas, TX

SUMMARY
Patients undergoing Roux-en-Y gastric bypass surgery were randomized to receive ropivacaine 0.2% or normal saline (controls) at 4 ml/hr via 5-inch Soaker catheters placed in the subfascial and subcutaneous tissue and connected to an ON-Q pump. The results showed no difference in pain scores, opioid consumption or hospital length of stay between the groups. However, the ropivacaine group ambulated one day earlier (P = 0.021) and sat in a chair one half day earlier (P = 0.038) compared to the control group. An incidental finding was that patients who had surgery on Friday used significantly more morphine after surgery than patients who had surgery on Monday or Tuesday.

ADVERSE EVENTS AND COMPLICATIONS
None reported

CONCLUSION
Patients receiving ropivacaine were found to ambulate earlier than the control group patients. Earlier activity in a bariatric patient could be very beneficial in reducing complications from deep vein thrombosis and improve patient recovery and return to activities of daily living.

5. Continuous Infusion of Intraperitoneal Bupivacaine after Laparoscopic Surgery: A Randomized Controlled Trial

AUTHOR
Sherwinter DA, et al

REFERENCE

STUDY DESIGN
Prospective, randomized, double-blind, placebo-controlled

NUMBER OF PATIENTS
30

SUMMARY
Patients undergoing laparoscopic adjustable gastric banding (LAGB) were randomized to receive bupivacaine 0.375% or normal saline (controls) at 2 ml/hr through catheters placed intraperitoneally adjacent to the site of maximal dissection for 48 hrs. The patients in the bupivacaine group had significantly lower pain scores both at rest and with cough from 6 hours postoperatively until the end of the study (P < 0.046 – 0.0091). There was also a trend towards significance related to a decrease in shoulder tip pain, with 10 patients reporting this in the control group vs. 2 in the bupivacaine group (P > 0.05).

ADVERSE EVENTS AND COMPLICATIONS
There were no complications related to bupivacaine or the use of the ON-Q system.

CONCLUSION
The use of intraperitoneal bupivacaine via ON-Q is safe and effective in providing postoperative analgesia for patients undergoing LAGB.
1. **The Use of a Continuous Popliteal Sciatic Nerve Block after Surgery Involving the Foot and Ankle: Does It Improve the Quality of Recovery?**

**AUTHOR**

White PF, et al.

**REFERENCE**


**STUDY DESIGN**

Prospective, randomized, double-blinded, placebo-controlled

**INSTITUTION**

UT Southwestern, Dallas, TX

**NUMBER OF PATIENTS**

24

**SUMMARY**

Patients undergoing foot or ankle procedures were randomized to receive a continuous popliteal nerve block with either bupivacaine 0.25% or saline at 5 ml/hr for 48 hrs. All patients had an initial nerve block performed for the surgery followed by general anesthesia. Patients in the bupivacaine group spent less time in the PACU, though the difference was not significant (69 ± 33 min vs. 98 ± 50 min). Fewer patients in the bupivacaine group required overnight hospitalization, though not statistically significant (6 of 10 vs. 10 of 10; P = 0.09). The average hospital length of stay was significantly shorter in the bupivacaine group (0.7 ± 0.7 days vs. 1.4 ± 0.5 days; P = 0.05). Median postoperative pain scores were significantly lower in the bupivacaine group on postoperative day 0 and 1, and were consistently (but not significantly) lower up to day 7. Maximal pain scores were significantly lower in the hospital and after discharge in the bupivacaine group (P < 0.05).

**ADVERSE EVENTS AND COMPLICATIONS**

Four patients had catheters dislodge before discharge from the hospital.

**CONCLUSION**

Continuous popliteal nerve block with an elastomeric pump infusing bupivacaine 0.25% at a rate of 5 ml/hr decreases postoperative pain and the need for opioid analgesic medication and improves patient satisfaction with pain management after painful orthopedic procedures involving the foot and ankle.

2. **Successful Continuous Interscalene Analgesia for Ambulatory Shoulder Surgery in a Private Practice Setting**

**AUTHOR**

Frederickson MJ, Ball CM, Dalgleish AJ

**REFERENCE**


**STUDY DESIGN**

Prospective observational study

**INSTITUTION**

Auckland Southern Cross Hospital, Auckland, AU

**NUMBER OF PATIENTS**

300

**SUMMARY**

Patients having elective shoulder surgery received a continuous interscalene (ISC) block using ultrasound-guidance and stimulating technique with ropivacaine 0.2% at 2 ml/hr with a 5 ml/hr bolus using ON-Q PainBuster. All patients were assessed for pain relief, adverse effects and related complications. Subgroups were also assessed by phone at 3 weeks postoperative for worst pain scores, satisfaction and dissatisfaction scores, and adverse neurological effects. Electromyography was conducted for symptoms persisting beyond 3 weeks. Results showed a 96% first attempt catheter success rate, and in all but one of the failures, catheters were adjusted or reinserted successfully in the PACU. Thirteen patients reported inadequate pain relief after discharge from PACU responding to increases in concentration of drug or administration of a bolus in 5 patients. Eight catheters were deemed malpositioned, three of which were replaced.

**ADVERSE EVENTS AND COMPLICATIONS**

Hoarseness was reported in 4%, mild dyspnea in 7%, Horner’s syndrome in 7% and prolonged dense motor block in 4%. New neurological symptoms attributable to the block occurred in 3 patients at 3 weeks and 1 patient at 4 weeks, which were resolved at 6 months.

**CONCLUSION**

Continuous ISC block for ambulatory shoulder surgery allowed avoidance of opioids in 98% of patients and was associated with a low complication rate.

3. **A Prospective Randomized Comparison of Ultrasound Guidance versus Neurostimulation for Interscalene Catheter Placement**

**AUTHOR**

Fredrickson MJ, Ball CM, Dalgleish AJ
CONTINUOUS NERVE BLOCK/ORTHOPEDIC

REFERENCE

STUDY DESIGN
Prospective, randomized, blinded to care-givers but not patients or investigator

NUMBER OF PATIENTS
Ultrasound (US) – 43; Neurostimulation (NS) - 39

INSTITUTION
Auckland City Hospital, Auckland, New Zealand

SUMMARY
A study was conducted to determine whether the use of ultrasound-guidance (US) would improve nerve block catheter placement compared to placement using neurostimulation (NS). Patients scheduled for elective shoulder surgery were randomized to either the US or NS group and subsequently had a nerve block catheter placed using the assigned technique. The catheters were connected postoperatively to the ON-Q PainBuster pump with ropivacaine 0.2% for continuous infusion at 2 ml/hr plus an on-demand 5 ml bolus per hour for 2 to 5 days. Fewer catheter interventions were required in PACU for the US group compared to the NS group (P = 0.007). Median ropivacaine bolus consumption was lower in the US group on day one (US = 1, NS = 10; P = 0.03). The number of patients requiring 2 or more tramadol for breakthrough pain was significantly lower in the US group on day 1 (P = 0.04), but not on day 2. The US group had a 50 second reduction in median needle-under-skin time (P < 0.001). There was no difference in patient satisfaction with pain management between the groups. All scores were high.

ADVERSE EVENTS AND COMPLICATIONS
Six patients (3 in US, 3 in NS) reported new neurologic symptoms at the day 10 consult.

CONCLUSION
After shoulder surgery, interscalene catheters placed with US demonstrated improved effectiveness during the first 24 hrs compared with those placed with NS.

4. Continuous Peripheral Nerve Blockade for Inpatient and Outpatient Postoperative Analgesia in Children

AUTHOR
Ganesh A, et al

REFERENCE
Anesth Analg 2007; 105(5):1234-42

STUDY DESIGN
Retrospective audit

NUMBER OF PATIENTS
226 catheters placed in 217 patients (age 4 – 18 yrs)

INSTITUTION
Children’s Hospital of Philadelphia

SUMMARY
An audit was made of the regional anesthesia outcomes for consecutive children who received continuous nerve blocks (CPNB) for orthopedic surgery from February 2003 through July 2006. The audit included interscalene, infracavicular, lumbar plexus, femoral and sciatic blocks. Continuous blocks were performed using bupivacaine 0.125% or ropivacaine 0.1% or 0.15% to deliver 0.1 – 0.15 ml/kg/hr (or < 0.3 mg/kg/hr) and were provided by either the CADD Prizm PCS II pump (N = 40) or ON-Q CB004 (N = 163). The results showed that 112 patients were discharged home with the pump, 39 of which were discharged on the day of surgery, and 64 on postoperative day one. 99% of these catheters were successfully removed by a family member at home. 18% of the patients required no opioids for postoperative pain, and 49% required only PRN opioids, half of which were oral preparations.

ADVERSE EVENTS AND COMPLICATIONS
Overall failure rate 15%, most due to catheter dislodgement. Motor blockade occurred in 24 patients (11%). Complications noted in 2.8% including neurological complications in 3 patients (all resolved spontaneously); one superficial cellulitis; one difficulty removing catheter at home; and one tinnitus that resolved with clamping of catheter. Incidence of nausea and vomiting 14% and was more frequent in patients who received intraoperative opioids (P = 0.001)

CONCLUSION
CPNB following orthopedic surgery can be successfully performed in children and tolerated well by patients in the hospital and at home.
5. **Analgesic Effectiveness of a Continuous Versus Single-Injection Interscalene Block for Minor Arthroscopic Shoulder Surgery**

**AUTHOR**
Fredrickson M, Ball CM, Dalgleish AJ

**REFERENCE**

**STUDY DESIGN**
Prospective randomized

**NUMBER OF PATIENTS**
30 single shot blocks; 31 continuous blocks

**INSTITUTION**
Middlemore Hospital, Auckland, NZ

**SUMMARY**
Patients undergoing interscalene block for arthroscopic subacromial decompression (acromioplasty), arthroscopic excision lateral clavicle (Mumford Procedure), arthroscopic anterior or posterior labral repair (stabilization) were randomized to receive a single shot nerve block with ropivacaine 0.5% 30 ml, or a single shot block plus a continuous infusion of ropivacaine 0.2% at 2 ml/hr plus an on-demand bolus of 5 ml per hour via the ON-Q pump. The two groups were compared in terms of pain at rest and movement using numerical rating pain scores (NRPS), need for supplement tramadol for pain, and sleep quality. The results showed the NRPS pain scores were lower at rest and with movement in the continuous group vs. single shot on day 1 (P = 0.007 and 0.008) but were similar on day 2. Significantly fewer tramadol tablets were taken in the continuous group on day one (P < 0.001) and day two (P = 0.017). Proportion of night slept was higher in continuous group (P = 0.08, trending towards significance). There was no difference in patient satisfaction.

**ADVERSE EVENTS AND COMPLICATIONS**
Arm numbness was subjectively higher in the continuous group. Four patients (3 in single shot, 1 in continuous) reported new neurologic symptoms at day 10. All were minor and resolved within 2 weeks.

**CONCLUSION**
After minor arthroscopic shoulder surgery, the addition of a continuous interscalene ropivacaine infusion to a single-shot interscalene block reduces pain, especially with movement, during the first 24 hrs. Patient satisfaction was equally high for both treatment groups.

6. **Home Peripheral Nerve Catheter Analgesia and the Single Anesthesia Physician**

**AUTHOR**
DeRuyter ML, Cheney JL, Rockford MA, Harrison BA, Horton G

**REFERENCE**
Presented at ASRA 2009

**STUDY DESIGN**
Prospective surveillance

**NUMBER OF PATIENTS**
153

**INSTITUTION**
Kansas University Medical Center, Kansas City, KS

**SUMMARY**
Adult patients undergoing foot and ankle surgery between 12/1/05 and 1/31/09 were offered a lateral popliteal continuous nerve block for postoperative analgesia using ropivacaine 0.2% at 10 ml/hr during inpatient stay, and switched to the ON-Q C-bloc pump at 5 ml/hr continuous plus 5 ml on-demand bolus per hour on discharge. Telephone follow up was conducted daily for 3 days by the anesthesiologist who performed the block. The mean duration of infusion was 2.27 + 0.55 days. The mean visual analogue score (VAS) for pain was 2.5 + 1.7. No patients reported difficulty in removing their home peripheral nerve catheter (PNC).

**ADVERSE EVENTS AND COMPLICATIONS**
There were 38 patient events reported and 3 sought medical attention at the ED for inadequate analgesia. Of the 3 who were seen in ED, one infusion had completed, one was deemed a “failed block” and one pump malfunctioned. There were 11 reports of leakage, 1 early catheter dislodgement, 4 disconnected catheters, and 3 pump malfunctions. Patient concerns included 4 with reports of metallic taste, 2 with pain after discharge of the catheter, 3 with skin reaction. No patients had symptoms of local anesthetic toxicity.

**CONCLUSION**
Results would suggest that the single anesthesia physician could provide the care for patients with a home peripheral nerve catheter.
7. Multicenter Continuous Peripheral Nerve Block Surveillance Study Comparing Ultrasound Guided Catheter Placement to Non Ultrasound Guided Catheter Placement Techniques

AUTHOR

REFERENCE
Presented at NYSORA 2008 and ASA 2009

STUDY DESIGN
Two-tiered open label surveillance study

NUMBER OF PATIENTS
1821 total; 1324 US, 497 Non-US

INSTITUTION
Multi-center

SUMMARY
Patients scheduled for orthopedic surgery were randomized to have peripheral nerve block catheters placed using either direct ultrasound visualization (US) or nerve stimulation (NONUS) techniques. Complication rates related to placement or management, time to place catheters, duration of continuous infusion and facility discharge times were recorded. There were significantly fewer vascular punctures reported in the US group compared to NS group [4/1324 [0.3%] vs. 8/497 [1.6%]; P = 0.0049]. Significantly more patients were discharged home with continuous infusion pumps in the US group vs. NONUS group (36% vs. 25%; P < 0.0001). There was no difference in time to place catheters between the groups.

ADVERSE EVENTS AND COMPLICATIONS
There was no difference in the rate of complications between the groups.

CONCLUSION
This series of subjects receiving continuous peripheral nerve blocks following orthopedic procedures revealed an overall low risk of complications and high rate of success. The time to place the initial block and position the catheter with ultrasound guided techniques was similar to traditional stimulator techniques. The use of US guided catheter placement for continuous peripheral nerve block placement may also result in an improved safety profile during the initial block.

8. Patient-Initiated Mandatory Boluses for Ambulatory Continuous Interscalene Analgesia: an Effective Strategy for Optimizing Analgesia and Minimizing Side-Effects

AUTHOR
Fredrickson MJ, Abeysekera A, Price DJ, Wong AC

REFERENCE
Br J Anaesth 2010 Nov 25; epub ahead of print

STUDY DESIGN
Prospective, randomized, open

NUMBER OF PATIENTS
38 mandatory + PRN bolus; 43 PRN bolus only

INSTITUTION
Auckland Southern Cross Hospital, Auckland, New Zealand

SUMMARY
Patients undergoing elective shoulder surgery with interscalene block were randomized to one of two groups based on postoperative analgesia regimen. One group received ropivacaine 2 ml/hr + 5 ml bolus/60 minutes PRN plus a mandatory bolus of 5 ml every 6 hours; the second group received the same treatment without the mandatory bolus. Continuous infusion and boluses were provided with two models of ON-Q pumps. The groups were compared for postoperative pain and numbness scores, night awakenings, tramadol consumption and side effects related to the treatment. Postoperative pain, night awakenings and tramadol consumption were similar between the groups on days 1 and 2. Day 2 PRN ropivacaine bolus requirement was lower in the mandatory + PRN bolus group (P = 0.002). Numeric scores for numbness and weakness were similar between groups on each day. There was no difference in patient satisfaction scores.

ADVERSE EVENTS AND COMPLICATIONS
Nine patients (21%) in the PRN only group vs. one (3%) in the PRN + bolus group had to temporarily stop the infusion because of side-effects. (P = 0.02). Of the 10 patients that stopped the infusion, 8 were due to numbness or weakness and 2 were due to dyspnea. There was no evidence of local anesthetic toxicity and no pneumothoraces.

CONCLUSION
Continuous interscalene ropivacaine 0.2% at 2 ml/hr with mandatory 6 hourly (and PRN) boluses provides similar analgesia after rotator cuff repair but with reduced side-effects compared with 5 ml/hr with PRN only boluses.
1. **Out with the Old, In with the New: A Novel Approach to Treating Pain Associated with Rib Fractures**

**AUTHOR**
Truitt MS, Mooty RC, Amos J, Lorenzo M, Mangram A, Dunn E

**REFERENCE**
World J Surg 2010; 22 June: epub ahead of print

**STUDY DESIGN**
Prospective, non-randomized

**NUMBER OF PATIENTS**
30

**INSTITUTION**
Methodist Health System, Dallas, TX

**SUMMARY**
Patients > 18 years (mean 65, range 22 – 92), presenting at a Level II trauma center with 3 or more unilateral rib fractures, were treated for pain associated with their injuries with placement of two ON-Q catheters in the extrathoracic, paraspinous muscles and infusion with ropivacaine 0.2% at 12 ml/hr via ON-Q pump to provide a continuous intercostal nerve block. Numeric pain scores (NPS) and sustained maximal inspiration (SMI) was measured pre- and post-placement of the catheters. There was a significant decrease in mean NPS from 9.03 pre- to 3.06 post-treatment (P < 0.05), and a significant increase in SMI from 0.40L pre- to 1.1L (P < 0.05) post treatment. One patient required mechanical ventilation. Catheters remained in place a mean of 98 hours and 60% of the patients were discharged with the therapy in place.

**ADVERSE EVENTS AND COMPLICATIONS**
There were no complications related to treatment.

**CONCLUSION**
The placement of catheters in the extrathoracic, paraspinous muscles appears to be a safe, viable, efficacious procedure for the amelioration of pain secondary to rib fractures.
1. Reduced Rates of Surgical Site Infection with the Use of Continuous Incisional Infusions of Local Anesthetic with ON-Q PainBuster: A Meta-Analysis of Clinical Studies

AUTHORS
Dine A, Johnson S, Saint John B

REFERENCE
Presented at Surgical Infection Society, 2007, Toronto, CANADA

STUDY DESIGN
Meta-analysis of 51 studies

NUMBER OF PATIENTS
4357

SUMMARY
Published and presented studies using the ON-Q PainBuster for incisional site delivery of local anesthetics for postoperative analgesia were evaluated for reported surgical site infection (SSI) rates. These data were compared to national average SSI rates as reported by the National Nosocomial Infection Surveillance (2004). The ON-Q studies spanned the surgical fields of Orthopedics, Plastics, General, Urology, OB-Gyn, Spine, CVCT, Bariatric and Colorectal surgery. The meta-analysis showed significant reduction of risk for SSI when continuous wound catheters were used (OR 0.433, P < 0.001); compared to CDC reported national average of 2.11%, the reported SSI rate in clinical trials using the ON-Q PainBuster was 0.7% overall. Sub-analysis by surgical procedure confirmed these general findings.

ADVERSE EVENTS AND COMPlications
Not studied beyond SSI.

CONCLUSION
Both quantitative and qualitative systematic review identified the benefit of continuous wound catheters reducing the risk of SSI. Future large, randomized controlled trials will be valuable to confirm these findings.


AUTHOR
Charous S

REFERENCE

TYPE OF STUDY
Retrospective review

INSTITUTION
Rush University Medical Center

NUMBER OF PATIENTS
28

SUMMARY
Patients undergoing thyroidectomy, parotidectomy, neck dissection, or a combination of these procedures who had ON-Q for postoperative pain management were compared to a control group who had the same procedures without ON-Q. Pain scores were significantly lower in the ON-Q group on postoperative day 1 (P = 0.0001), and the mean total opioid use was also significantly less (P = 0.025). Postoperative nausea and vomiting (PONV) was also reported as less. There was no difference noted in length of stay.

ADVERSE EVENTS AND COMPlications
There were no wound infections, nerve pareses, or any other complications as a result of the catheter placement.

CONCLUSION
When compared with current standard pain control protocols using oral and injectable opioid agents, the use of a continuous infusion of local anesthetic to the surgical wound site has significant advantages with minimal associated risks.