Pain Management following Total Knee Arthroplasty

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Total Knee Arthroplasty

- Knee OA is common worldwide with attendant disability sufficient enough to impact society socioeconomically
- TKA is a proven procedure that enables disabled patients to return to meaningful functional activity
TKA

- Highly reproducible
- Highly successful
- High quality of function
- Highly durable
- “Most surgeons can do it well”
TKA Survivorship

CRR(%) vs Year after index operation

- OA
- All Revisions
- TKA

Year after index operation:
- 1976-1980: 671
- 1981-1985: 2,125
- 1986-1990: 4,034
- 1991-1995: 12,130
- 1996-2000: 20,351
- 2001-2005: 34,230
- 2006-2009: 39,837

Swedish Knee Registry
Patient Reported Outcome Measures

- Patients and Doctors have differing perceptions of domains of outcome
- Discrepancy between patient and surgeon satisfaction
Common Outcome Measures

- **Oxford Knee Score**
  Freely available, simple and brief, low ceiling effect

- **KOOS**
  Suitable younger and/or active patients

- **WOMAC**

- **Knee Society Score**
  Clinician completed
Generic Tools

- Broader perspective
- May not be responsive to clinically important change
- SF-36
  - Physical and Mental Scale
PROMs

- Assessment limited due to ceiling effects as designed to assess pain and basic activities of daily living
- May not correlate with patient satisfaction
### Published Satisfaction % after TKA

<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>Followup (years)</th>
<th>Satisfied (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson et al. [2]</td>
<td>74</td>
<td>1–5.5</td>
<td>89</td>
</tr>
<tr>
<td>Noble et al. [22]</td>
<td>253</td>
<td>1</td>
<td>75</td>
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<tr>
<td>Robertsson et al. [23]</td>
<td>27,372</td>
<td>2–17</td>
<td>82</td>
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<tr>
<td>Wylde et al. [26]</td>
<td>228</td>
<td>2</td>
<td>85</td>
</tr>
<tr>
<td>Hawker et al. [12]</td>
<td>1193</td>
<td>2–7</td>
<td>85</td>
</tr>
<tr>
<td>Heck et al. [14]</td>
<td>291</td>
<td>2</td>
<td>88</td>
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<tr>
<td>Bourne et al</td>
<td>1703</td>
<td>1</td>
<td>81</td>
</tr>
</tbody>
</table>
Patient satisfaction

Distribution of satisfaction, percent

Swedish Knee Registry
Factors associated with satisfaction

- Less pre-op pain
- General health, emotional role of SF 36
- Age
- $\Delta$ OKS $> 11$ points
- Worse pre-op mental health depression
- Less education
- Greater BMI

PATIENT EXPECTATIONS
Harris Interactive Survey

Patients

When all osteoarthritis patients were asked specific questions about joint replacement surgery:

- More than 60 percent (61%) reported a concern over the need for additional procedures following surgery
- 60 percent were afraid of incorrect joint alignment associated with surgery
- Nearly 50 percent (49%) were concerned about the pain associated with recovery
- 56 percent were concerned about the length of the recovery period
- More than 80 percent (83%) want their physicians to offer them the latest treatment approaches available.
- When deciding what treatment approaches to follow, osteoarthritis patients are most likely to be influenced by a treatment’s ability to ease pain (87 percent) and increase motion (83 percent).
Patients Concerns Prior to undergoing THA and TKA

- Pain after surgery
- Length of recovery
- Ability to walk as much as wish
- Ability to return to recreational activities

Trousdale et al Mayo Clinic Proc 1999
What patients really want

- Relief of pain
- Restoration of full knee function
- Minimal side effects of surgery
- Achieving quick recovery
SURGICAL APPROACH

- CLASSIC APPROACH

- WIDE VISIBILITY
- EXTENSOR MECHANISM
- REPRODUCIBLE FIXATION
- ALIGNMENT
- ROM
- LIGAMENT BALANCE
Minimally Invasive TKA

- Overwhelming theme at AAOS 2005
- Patient driven agenda
- Insurance driven
- Company driven
- Orthopaedic ego driven
MIS

Make it difficult surgery
MIS Pain Management with Standard Incision

- 25 arthroplasties

Nuelle et al J Arth 2007
The concept of MiTKA is an ATTITUDE

- Patient selection
- Patient education
- PAIN CONTROL
- Accelerate Recovery
Pain

- Activation of nociceptive pathways leads to the experience of pain. The pathway can be stimulated or modified by endogenous and exogenous stressors.

- **Endogenous stressors** include tissue damage and inflammation

- **Exogenous stressors** include psychological and social factors.
TKA REHABILITATION

- Influenced By Many Factors
  - Preoperative Education
  - Preoperative Exercise Program
  - Patient Selection
  - Anesthetic Methods
  - Adequacy Of Perioperative Analgesia
  - Clinical Care Pathways
  - Physiotherapy Program
  - Motivation
    - Patient & Physician
PREOPERATIVE EDUCATION

- Educational Manual
  - Arthritis
  - Anesthetic Options
  - Operative Procedure
  - Rehabilitation Program
- Videotape
- Preoperative Class
  - Patients and Family
  - Mobilise Family
PREOPERATIVE EDUCATION

↓ Anxiety Scores
Quicker Pain Reduction
Faster Rehabilitation

Giraudet - Le Quintrec, et al, CORR 2003
Spaulding, Occup Ther Int, 2003
Critical For Accelerated Rehabilitation Following Total Knee Arthroplasty
PAIN PATHOPHYSIOLOGY

- Mediated Via Two Pathways
  - Neurogenic
  - Inflammatory
    • Direct Tissue Damage
    • Cytokines / Prostaglandins
    • Other Chemical Mediators
PAIN PATHOPHYSIOLOGY

- Tissue Damage
  - Direct Neural Damage & Release Of Inflammatory Mediators
  - Sensitization Of Peripheral Nociceptors
  - ↑ Afferent Transmission Of Pain Stimuli To Dorsal Horn Cells Resulting In CNS Hypersensitivity
    • PAIN
TRADITIONAL PAIN MANAGEMENT REGIMENS

- Intermittent Administration of Analgesics Based On Patient Demand
  - Pain Stimuli Present BEFORE Analgesics Delivered
    - Renders Analgesics Less Effective
    - Higher Doses Often Required
PREEMPTIVE ANALGESIA

Analgesia Administered Before Tissue Injury Can Lessen Neuronal Hyperexitability In CNS Resulting In ↓ Pain

PD Wall, Pain, 1988
PREEMPTIVE ANALGESIA

- Methods To ↓ Sensory Input
  - Local Anesthetic Infiltration
  - Regional Anesthesia
    - Less Effective Than Local Infiltration
  - Preoperative Medications
Multi-modal Preemptive Analgesia

- **NSAIDs** target both central nervous system and local inflammatory factors
- **Opiates** and **Paracetamol** which works centrally
- **Neuroleptics** e.g. gabapentin and pregabalin.
- The positive effects of such drugs have been shown to reduce opiate consumption postoperatively.
- **Intravenous corticosteroid at induction and during postoperative period** -


Mallory TH1, Lombardi AV Jr, Fada RA, Dodds KL, Adams JB.
ANAESTHETIC METHODS

- Must Avoid:
  - Postoperative Nausea
  - Over-Sedation
  - Prolonged Motor Block
ROUTEINE ANTI-EMETICS

- Various Medications Utilized
  - Routine Administration (24-48 Hrs.)
- Analgesic-Induced Nausea
- Avoid dehydration postop
Intra-Operative Analgesia

GA versus RA. Within RA, options of central VS peripheral nerve blockade

- RA has the advantage of superior postoperative pain relief, better patient rehabilitation as well as a shorter hospital stay.
- GA on the other hand, does not carry the risk of block failure, and spares the patient of a possible fearful experience.
- Most surgeons prefer regional over general anaesthesia.
- Pros - patients experiencing less postoperative pain, less nausea and vomiting, as well as safety considerations.
  Cons - the delay in the induction or administration of regional anaesthesia, on top of the possible block failure risk.

Macfarlane et al found inadequate evidence to conclude whether GA or RA is superior in influencing mortality or reducing cardiovascular complications.

Analysis of more recent trials showed no difference in blood loss or prevalence in thromboembolic events between the two techniques. However, RA does provide better post-operative pain relief, and reduces side effects due to opioid administration. In addition, RA may also provide advantage in reducing hospital length of stay and improving rehabilitation progress.

Lower Tourniquet Cuff Pressure Reduces Postoperative Wound Complications After Total Knee Arthroplasty: A Randomized Controlled Study of 164 Patients

Charlotte Oliveira, RN\textsuperscript{1}; Sari Ponzer, MD, PhD\textsuperscript{1}; Per Hamberg, MD, PhD\textsuperscript{1}; Richard Blomfeldt, MD, PhD\textsuperscript{1}

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View Disclosures and Other Information

Less Invasive Approach

- 'Quads sparing' but tendon violating
- Incision kept within quads tendon
  ~ 3 cm proximal to superior pole of patella.
Post Operative Anaesthesia

- Traditional postoperative pain control involved the use of intravenous opiate infusion such as patient controlled analgesia (PCA).
- Problems of PCA: nausea and vomiting and postoperative ileus.
Anaesthetic Methods

- Can Facilitate Postop Analgesia
  - Various Postop Regional Blocks
    - Epidural - less commonly used - difficulty of use with anticoagulation, the incidence of urinary retention and prolonged immobility.
    - Spinal +/- Intrathecal Morphine
    - Lumbar Plexus
    - Femoral Nerve
    - Femoral & Sciatic Nerves
Nerve Blocks

- Each individual patient has to be assessed for the suitability of various analgesia options.
- Femoral block is a good option in managing post TKA pain, subject to availability and hospital resources.
- Some surgical centers have attempted a combination of femoral and sciatic nerve blocks, but this has not been shown to be superior to that of femoral nerve block with local analgesia infiltration.
- Alternative option - use of femoral nerve block with selective tibial nerve block, which can be performed in the popliteal fossa - avoids complete peroneal motor block and provides similar postoperative analgesia compared to sciatic block.
Nerve Blocks

- Possible complication that may arise from each of the options has to be discussed with the patients pre-operatively.
- The use of femoral catheters can result in serious complications such as compartment syndrome or vascular injury.
- Risk of producing foot drop, which may mask any potential iatrogenic peroneal nerve injury.
Local Injection

- Adjunct To Systemic Analgesics
- Can Be Done Preemptively
  - More Effective In Some Studies
Local Injection

- Local analgesia infiltration offers the advantage of providing pain relief without the effects of regional motor blockade, which can potentially affect early rehabilitation.

- Local analgesia infiltration provides adequate pain relief and early mobilisation

- Various ‘cocktails’ - morphine, long acting local anaesthetic agents such as bupivacaine, injectable NSAIDs eg Ketorolac, alpha receptor blockers eg clonidina; and in some reports use of corticosteroids.

Multimodal Pain Cocktail

- Peri-Articular Injection
  - Bupivacaine with Adrenaline
  - Morphine
  - Triamcinolone
  - Ketorolac
  - Antibiotic

↓ Patient Pain
↓ Opioid Use
↑ Patient Satisfaction

Seah et al SMJ 2011
Ng YC et al KSSTA 2011
Pang et al JBJS B 2008
Unassisted SLR on POD #1 in an octagenarian
PCA With Local Anaesthesia Infiltration or regional anaesthesia?

- Yadeau et al concluded that patients with femoral block + PCA resulted in a lower pain score when walking, but was no different from the local analgesia infiltration group when patients were at rest.

- The mean opioid use was higher in the local analgesia infiltration group overall, although this did not affect patients' length of hospital stay.

- Consistent with that of Meftah et al and Widmer et al, where both the American and Australian experience too, echoed higher use of opioids in patients who received local analgesia infiltration.


## RCT Nerve Block vs Injection Study Results

- **Mean pain score**

<table>
<thead>
<tr>
<th></th>
<th>Nerve Block</th>
<th>Injection</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery Rm Arrival</td>
<td>2.3</td>
<td>2.6</td>
<td>0.51</td>
</tr>
<tr>
<td>Patient Rm Arrival</td>
<td>1.3</td>
<td>2.0</td>
<td>0.02</td>
</tr>
<tr>
<td>Day of Surg - Evening</td>
<td>1.6</td>
<td>2.3</td>
<td>0.02</td>
</tr>
<tr>
<td>POD 1 am</td>
<td>2.0</td>
<td>2.5</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>POD 1 pm</strong></td>
<td><strong>2.9</strong></td>
<td><strong>3.0</strong></td>
<td><strong>0.76</strong></td>
</tr>
<tr>
<td>POD 1 Evening</td>
<td>2.3</td>
<td>2.9</td>
<td>0.07</td>
</tr>
<tr>
<td>POD 1 Mean</td>
<td>2.4</td>
<td>2.8</td>
<td>0.15</td>
</tr>
<tr>
<td>POD 2 Mean</td>
<td>1.7</td>
<td>1.5</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Spanggehl et al AAOS 2014
RCT Nerve Block vs Injection

Conclusions

- Patients who received a periarticular injection vs peripheral nerve blocks had:
  - Similar pain and satisfaction scores
    - ~ 2 pain & > 9 satisfaction
  - Higher narcotic use on day of surgery
    - 23mg vs 17mg
  - Shorter length of stay by almost ½ day
    - 2.4 vs 2.8
  - Lower neurologic sequelae
    - 1% vs 9%
RCT Nerve Block vs Injection Study Results

- Complications
  - No difference in any complications except peripheral neurologic sequelae

- Sensory changes at 6 weeks
  - 9 (12%) PNB vs 1 (1%) PAI (p=0.009)

- 3 falls in the PNB; 0 in the PAI
  - Not significantly different

Spanghel et al AAOS 2014
CRYOTHERAPY

- Potential Analgesics Benefits
  - Vasoconstriction
    - ↓ Bleeding / Edema
  - Relative Muscle Spindle Deactivation Resulting In Decreased Muscle Spasm
  - ↓ Nerve Impulse Conduction
  - ↓ Excitability Of Nerve Endings
    - Raises Pain Threshold
CRYOTHERAPY

- Vs epidural
- Similar pain scores
- Better ROM
- Earlier discharge

Kullenberg et al J Arth 2006
Liposomal Bupivacaine

- Bupivacaine
- Aqueous core
- Multivesicular system of liposomes
- Phospholipid bilayer
- Body heat...Gradual corrosion of membranes...release of bupivacaine

Pharmacokinetics

- Initial peak due to 3% extravasal liposomal bupivacaine
- Second peak due to slow release of bupivacaine from DepoFoam
- EXPAREL 266 mg
- P1: 0-2 hours
- P2: 24-48 hours
- Duration: 96 hours

Presented at the 2009 International Anesthesia Research Society Annual Meeting; March 14-17, 2009, San Diego, CA.
Liposomal Bupivacaine Versus Traditional Periarticular Injection for Pain Control After Total Knee Arthroplasty

Deren Bagsby, MD, Phillip H. Ireland, MD, R. Michael Meneghini, MD

Received 10 January 2014; received in revised form 18 March 2014; accepted 29 March 2014. Published online 07 April 2014.

Abstract

The purpose of this study was to compare a novel liposomal bupivacaine to traditional peri-articular injection (PAI) in a multi-modal pain protocol for total knee arthroplasty (TKA). A retrospective cohort study compared 85 consecutive patients undergoing TKA with a traditional PAI of ropivacaine, epinephrine and morphine to 65 patients with a liposomal bupivacaine PAI. After the initial 24 hours, inpatient self-reported pain scores were higher in the liposomal bupivacaine group compared to the traditional PAI group (p = 0.04) and a smaller percentage (16.9%) of patients in the liposomal bupivacaine group rated their pain as “mild” compared to the traditional group (47.6%). Liposomal bupivacaine PAI provided inferior pain control compared to the less expensive traditional PAI in a multi-modal pain control program in patients undergoing TKA.
Summary

- Realistic post-operative outcome expectation forms an important part of patient education pre-operatively. Meticulous patient selection, peri-operative anaesthetic support, post-operative recovery and rehabilitation are the key factors in achieving consistent patient outcomes in total knee arthroplasty.

- The management of pain starts pre-operatively with options of multi-modal pre-emptive analgesia.

- Regional anaesthesia has potential in providing better post-operative pain relief with reduced side effects due to opioid administration.
Both nerve blocks and local infiltration of analgesia are good options in managing post TKA pain, subject to availability and hospital resources.

The use of adjuncts including cryotherapy can potentially decrease the total amount of analgesics required by the patients during post-operative recovery.
‘also, there is a fracture and I need to fix it…..’