I’ve Got You Under My Skin:
A Comparison of IV and s/c PCA

Nick Williamson  Clinical Nurse Specialist
How did PCA get under my skin?

Started in 2009 when I started working at KCH

Subcut PCA !!!

PCA refers to an electronically controlled infusion pump that delivers an amount of *intravenous* analgesic when the patient presses a button.
How did PCA get under my skin?

Started in 2009 when I started working at KCH

Subcut PCA ! ! !

Observations:

Seemed to work well

Not so much PONV
How did PCA get under my skin?

Oct/Nov 2014
MSc Dissertation
Submission: Spring 2015

The planned (acupuncture) study snagged at R&D stage.

KCH acquired the PRUH in 2013.

There was 6 month’s worth of (IV) PCA data from the PRUH available.

At KCH there are at least 25 (s/c) PCA patients each week.

Prospective data collection and compare.
What do we know about PCA?

Early studies compared IV PCA with IM analgesia.

- PCA provided better analgesia
- similar incidences of side effects sometimes with a reduced consumption of opioid
- sometimes a shorter hospital stay

Bennett et al 1982; Finley et al 1984; Bollish et al 1985
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On a 100 point scale!
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<td>PCA significantly more than IM</td>
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Patient satisfaction

Meta-analysis of both the degree of satisfaction and the number of patients satisfied with therapy significantly favoured patients in the PCA group

Hudcova 2006
McNicol 2015
s/c PCA – What do we know?

- 6 papers reported to compare IV and s/c PCA:

  “Data on the effectiveness of SC PCA compared with IV PCA are variable and inconsistent.”

  “Both similar and significantly better pain relief has been reported.”

  “The same or a higher incidence of nausea and vomiting or pruritus.”

  “Compared with IV PCA, SC PCA may result in higher opioid use, or may not.”
Comparis subcutaneous

H. Keita*, N. Ge
Department of Anesthesia

Nurse-Administered Satisfactory After Analgesia Morph

Andrew J. Murray, FRC
James W. Sleight, FAN:
Department of Anesthesia

Murray L.

Patient-controlled analgesia (PCA) has the advantage of allowing the patient to administer analgesia as needed. However, there is a delay between the patient's request and the delivery of analgesia, which may lead to discomfort. The effectiveness of the technique is influenced by the patient's pain perception and ability to self-administer analgesia.

PCA: An Alternative to IV-PCA

Subcutaneous-PCA: An Alternative to IV-PCA

Postoperative Pain Management

Paul F. White, M.D., Ph.D.

Alcohol has been shown to be an effective analgesic for postoperative pain management. This study evaluated the use of subcutaneous PCA in patients undergoing various surgical procedures.

Key words: Analgesia, narcotic, hemodynamic, postoperative pain.
s/c PCA – What do we know?


s/c PCA – What do we know?

- 6 papers claimed to compare IV and s/c PCA
- 3 actually do so (Urquhart 1988, White 1990, Dawson 1999)
- Pain relief using s/c PCA is either the same or better than pain relief using IV PCA
- Nausea may be less of a problem using the s/c route
- Patients tend to use more opioid when using s/c PCA than when using IV PCA.
Pharmacokinetics of morphine after S/C & IV boluses.
Stuart-Harris et al 1999

The mean values for $C_{max}$, AUC, CL and $V_d$ after s.c.b. were very similar to the respective parameters for i.v. administration.

The median $t_{max}$ after s.c.b. morphine was significantly longer than after i.v. morphine (0.25 vs 0.08 h, $P<0.001$).

Nevertheless, this difference was relatively small and may not be significant clinically.

Post-administration samples taken at: 0.08, 0.17, 0.25, 0.50, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 8.0, 10.0 and 12.0 h
The Study:

I’ve Got You Under My Skin: 
A Comparison of IV and s/c PCA
s/c and IV PCA – a comparison of two service evaluations

Method

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Primary outcome measure: Pain Score (conversion required)
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<th>NRS pain score</th>
<th>VRS pain score</th>
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<tbody>
<tr>
<td>0</td>
<td>0 - no pain</td>
</tr>
<tr>
<td>1 - 4</td>
<td>1 - mild pain</td>
</tr>
<tr>
<td>5 - 6</td>
<td>2 - moderate pain</td>
</tr>
<tr>
<td>7 - 10</td>
<td>3 - severe pain</td>
</tr>
</tbody>
</table>

(Jensen et al 2003)
s/c and IV PCA – a comparison of two service evaluations

Method

**PRUH**
Retrospective analysis of data collected by pain nurses on the day after commencement of PCA
Dec 13 – May 14

**KCH**
Prospective collection of data on the day after commencement of PCA
Dec 14 – Feb 15

Primary outcome measure:
Pain Score (conversion required)

Secondary outcome measures:
PONV (Y/N)
Itch (Y/N)
Adverse Incidents

Additional data:
PCA demands, good/bad
Peri-operative factors (time in theatre, volatile agents, loading doses, etc)
Anti-emetics, alternative analgesia
Continuous data sets (age and opioid doses delivered), were assessed for normality of distribution of the samples. There were none.

Standard statistical analyses were used:

$\chi^2$ for categorical data (or Fisher's exact test if one of the cross tabulated cells had an expected frequency of 5 or less)

Mann-Whitney U and Kruskal-Wallace tests were used for continuous data.

Spearman's correlation coefficient was employed for correlations.

Significance value ($\alpha$) was set as $P = 0.05$ for all analyses.

All statistical analyses used IBM SPSS version 22
Results

s/c PCA n = 86

IV PCA n = 74
KCH n=86

- Abdo: 45
- Gynae: 16
- Ortho: 4
- Neuro: 9
- Vasc: 7
- CT: 4
- Other: 4

PRUH n=74

- Abdo: 47
- Gynae: 3
- Ortho: 5
- Other: 3
- Vasc: 45
Results

There were no significant differences between the two groups with regard to age and admission pathway (elective or via A&E).

There were significant differences with regard to sex, even after excluding gynae patients.

s/c PCA n = 86

IV PCA n = 74
The largest group of patients in both hospitals were those having abdominal surgery.

KCH n=86
- Open abdo surgery: n = 11
- Laps abdo surgery: n = 28

PRUH n=74
- Open abdo surgery: n = 26
- Laps abdo surgery: n = 3
(some PRUH data missing)
The largest group of patients in both hospitals were those having abdominal surgery.

**KCH n=86**
- Open abdo surgery: n = 11
- Laps abdo surgery: n = 28

**PRUH n=74**
- Open abdo surgery: n = 26
- Laps abdo surgery: n = 3
  (some PRUH data missing)
Open Abdo Results

There were no significant differences between the two groups with regard to age, sex or admission pathway.

s/c PCA n = 11

IV PCA n = 26
No Pain | Mild Pain | Moderate Pain | Severe Pain
---|---|---|---
23% | 48% | 22% | 7%

$P = 0.001$
Pain – Open Abdo Surg

- 82% Mild Pain
- 9% No Pain
- 9% Moderate Pain
- 0% Severe Pain

$s/c$ PCA n=11

IV PCA n=26

$P < 0.001$
PONV n = 160
Itch

- s/c PCA n=86
- IV PCA n=74

\[ P = 0.057 \]
How well do the s/c PCA results stand up against published data?

McNichol (2015) Cochrane Review

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Mean VAS @ 24 hours</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chang 2004</td>
<td>62</td>
<td>16</td>
<td>Abdominal gynaecologic surgery</td>
</tr>
<tr>
<td>Wheatley 1992</td>
<td>19</td>
<td>19</td>
<td>Upper abdominal surgery</td>
</tr>
<tr>
<td>Crisp 2012</td>
<td>30</td>
<td>25</td>
<td>Vaginal reconstructive surgery</td>
</tr>
<tr>
<td>Chan 1995</td>
<td>12</td>
<td>26</td>
<td>Cholecystectomy</td>
</tr>
<tr>
<td>Ellis 1982a</td>
<td>20</td>
<td>27</td>
<td>Hysterectomy</td>
</tr>
<tr>
<td>Snell 1997</td>
<td>44</td>
<td>32</td>
<td>Major abdominal surgery</td>
</tr>
<tr>
<td>Hu 2006</td>
<td>40</td>
<td>33</td>
<td>Lower abdominal surgery</td>
</tr>
<tr>
<td>Thomas 1995</td>
<td>61</td>
<td>36</td>
<td>Total abdominal hysterectomy</td>
</tr>
<tr>
<td>Wasylak 1990</td>
<td>20</td>
<td>38</td>
<td>Gynaecologic surgery</td>
</tr>
<tr>
<td>Rayburn 1988</td>
<td>67</td>
<td>41</td>
<td>Caesarean section</td>
</tr>
<tr>
<td>Ellis 1982b</td>
<td>15</td>
<td>43</td>
<td>Cholecystectomy</td>
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<td>McGrath 1989</td>
<td>44</td>
<td>45</td>
<td>Cholecystectomy</td>
</tr>
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<td>Passchier 1993</td>
<td>17</td>
<td>46</td>
<td>Cholecystectomy, intestinal resection</td>
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PONV

- s/c PCA n = 86
- Cochrane IV PCA n = 766
- Cochrane IM n = 759
Itch

- s/c PCA n = 86
- Cochrane IV PCA n = 272
- Cochrane IM n = 272
Adverse incidents reported at KCH
(no adverse incidents reported at PRUH)

1. A patient who had undergone femoral nailing following a road traffic accident (RTA), required Naloxone 400mcg during the first post-operative night to reverse over-sedation accompanied by a respiratory rate of 7 breaths/minute and oxygen saturations of 89%.

2. A patient following foramen magnum decompression developed a rash using morphine PCA. The morphine PCA was switched to s/c oxycodone PCA (2mg/10minutes) with no further problem.

3. An elderly patient with fractured lumbar vertebrae following RTA developed confusion soon after commencement of morphine PCA and was found have an acute renal injury. Morphine PCA was switched to s/c Fentanyl PCA (20mcg/10minutes) with good effect. By the time of data collection the confusion was no longer apparent.
PCA usage and total morphine

<table>
<thead>
<tr>
<th>Good PCA Demands &amp; Total PCA Morphine Dose by PCA route</th>
<th>Hospital Total</th>
<th>Mean average per patient (median)</th>
<th>( P ) value</th>
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<td><strong>Good demands</strong></td>
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<tr>
<td>s/c PCA</td>
<td>2113 (n=86)</td>
<td>25 (25)</td>
<td></td>
</tr>
<tr>
<td>IV PCA*</td>
<td>2180 (n=69)</td>
<td>32 (24)</td>
<td>( P = 0.25 )</td>
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* 5 missing data sets

**IV PCA prescription:** 1mg/5minutes

**s/c PCA prescription:** 2mg/10minutes
# PCA usage and total morphine

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<td>Total PCA morphine (mg)</td>
<td>s/c PCA</td>
<td>4119 (n=86)</td>
<td><strong>49mg (49mg)</strong></td>
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<tr>
<td>IV PCA**</td>
<td>2240 (n=72)</td>
<td><strong>31mg (24mg)</strong></td>
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* 5 missing data sets
** 2 missing data sets
Patients using s/c PCA received twice as much morphine as those using IV PCA.

This may explain the finding of superior analgesia...

Despite receiving twice as much morphine, the side-effect burden was reduced.
s/c PCA – What do we know?

- 6 papers claimed to compare IV and s/c PCA
- 3 actually do so (Urquhart 1988, White 1990, Dawson 1999)
- Pain relief using s/c PCA is either the same or better than pain relief using IV PCA
- Nausea may be less problematic using the s/c route
- Patients tend to use more opioid when using s/c PCA than when using IV PCA.
Limitations

Sources of bias

Data collector
Pain

![Graph showing percentage distribution of pain levels]

- **No Pain**:
  - 2014/15: 23%
  - 2011/12: 33%

- **Mild Pain**:
  - 2014/15: 48%
  - 2011/12: 46%

- **Moderate Pain**:
  - 2014/15: 22%
  - 2011/12: 13%

- **Severe Pain**:
  - 2014/15: 7%
  - 2011/12: 8%
PONV

- 2014/15 n = 86
- 2011/12 n = 136

16%

9%
Limitations

Sources of bias

Data collector bias
Seasonal bias

Single data collection point

Alignment of two pain score tools

Binary N&V score

Lack of homogeneity of samples
Conclusions

Seems to be effective

It’s not worse than IV!

Seems to have a reduced side effect burden

Less painful cannulation

No risk of phlebitis

Reduced risk of infection

6.2% HA bacteraemia from peripheral IV lines (NINSS 2002)

More consistent analgesia – anyone can re-site a s/c cannula
The next steps:

A cross-over study is currently in the planning stages...