Choice Architecture Nudge Theory improves post-op analgesia delivery

Title

Successful use of 'Choice Architecture' and "Nudge Theory" in a quality improvement initiative of analgesia administration after Caesarean section

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Abstract

Background: Regular, routine, multimodal analgesia provides better pain relief following Caesarean section than reliance on “as required” opiate dosing. This quality improvement report describes the effective use of an education program coupled with a highlighted, pre-printed medication chart, employing “Nudge Theory” principles to achieve significant improvements in the administration of analgesic medications to patients after Caesarean section operations.

Problem: An acute pain service audit identified a serious deficiency with delivery of regular post-operative analgesic medications to patients following Caesarean section operations.

Methods: An audit of pain medication delivery to patients following Caesarean section demonstrated that postoperative analgesia was not being administered in line with local prescribing guidelines. Two interventions were planned:

1. Education sessions for anaesthetic recovery and ward staff.
2. Introduction of a new pre-printed and highlighted medication chart.

A post-intervention audit was then conducted.

Results: There were statistically significant improvements in all medications administered to patients following the two interventions. For analgesic medications the rate of administration of drugs in compliance with guidelines rose from 39.6% to 89.9% ($p < 0.001$ using 2-sample z-test). Each subgroup of medications also showed statistically significant improvements in administration compliance.

Conclusion: A combined approach, including application of “Nudge Theory” to the administration of analgesic medication after Caesarean section, considerably improved delivery of medications prescribed for postoperative analgesia.

Introduction

Caesarean section is an increasingly common method of delivering babies worldwide. In Victoria, Australia 32% of deliveries were via Caesarean section in 2011 (1). Caesarean section is a major intra-abdominal operation with the likelihood of significant pain and associated analgesia requirements in the post-operative phase (2). The PROSPECT guidelines recommend a multimodal analgesic approach to postoperative pain management (3). Despite such guidelines there is good evidence to suggest that administration of analgesic medications to the patient may not occur reliably (4). Medication errors are common in healthcare and have been described in anaesthetic practice (5,6). These can amount to high levels of error in specialist areas of practice (7).

An audit of analgesic provision to patients following Caesarean section delivery in a tertiary teaching hospital demonstrated poor compliance with recommended guidelines and local prescribing. The poor compliance was identified as unreliable administration of regular analgesic prescriptions by midwives in the postoperative ward.

A survey of the nursing staff administering prescribed medications for postoperative pain relief indicated a wide variety of reasons for medication omissions. Consequently it was decided to use the relatively new science of behavioural economics in the form of "Nudge Theory" by employing "choice architecture" to establish a clearer method of highlighting prescribed postoperative analgesic medications (8). The concept of "Nudge Theory" has emerged from studies in behavioural economics to explain and drive improved decision making and can be employed in healthcare (8)(9). A 'Nudge' is defined as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (10). This method was used alongside an education programme for anaesthetists and postoperative care ward staff. An assessment of the guideline compliance before and after the introduction of the two interventions was incorporated into the quality improvement project.

Methods

Exemption from ethics review was granted by the Barwon Health Research Ethics, Governance & Integrity (REGI) Unit, as outlined in the National Statement on Ethical Conduct in Human Research, Section 5, Australia (11)(9).

A retrospective audit of medication charts for 100 patients, who had undergone Caesarean section under spinal anaesthesia, were reviewed to confirm that the correct analgesic medications had been prescribed in compliance with the local guidelines (See aAppendix 1). A further check was carried out to confirm the analgesic medications had been administered correctly. Compliance was assessed for the first 48hrs. Medication administration was assessed as compliant if the patient had received four doses of paracetamol, three doses of diclofenac or an alternative non-steroidal anti-inflammatory drug (NSAID) and two doses of slow release oxycodone in each 24hr period up to 48hrs following surgery. Patients who had received a general anaesthetic or were taking opioid replacement therapy (methadone, buprenorphine) were excluded from the audit.

Two interventions were planned as a result of the identified low rate of administration of analgesic medications. The first intervention was an education program for postoperative ward nursing staff, emphasising the importance of regular medication prescription and administration. Education sessions were undertaken by a pain nurse, a pharmacist and an anaesthetist. The second intervention included changes to the inpatient medication chart. The medication chart was altered

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to include highlighted, pre-printed medication orders for all regular analgesia, breakthrough analgesia and aperients as well as per protocol orders for post-operative nausea and vomiting treatment. Venous thromboembolism (VTE) thromboprophylaxis was also included as a highlighted component of the medication chart. The highlighted prescriptions were made in consultation with the pharmacy department and medication safety committee. (Insert Figure 1 hereSee Appendix 2. The revised medication chart showing use of choice architecture to highlight important postoperative medication)).

A post-intervention audit was conducted 12 months after these two interventions.

Raw data was collected and collated in Microsoft Excel. Proportions between the groups in the first and second audit were compared using a 2-sample z-test in Stata v.14.

Results

Four patients were excluded from the first medication chart audit, and one patient was excluded from the second medication chart audit leaving 96 and 99 patients respectively.

Compliance with the prescribing guidelines was high in both data analyses with 100% complete and correct written prescription in each audit of the medication charts. If patients were allergic to the guideline medication or had contraindications to the drug prescription and the prescription was omitted this was counted as correct prescribing.

An analysis was also undertaken to identify correct administration of the prescribed post-operative analgesic medication. Examination of each analgesic medication (paracetamol, NSAID and oxycodone) indicated statistically significant improvements in administration of each medication after introduction of the education sessions and highlighted and pre-printed medication chart.

(See Tables 1,2 & 3)

The same prescribing analysis was applied, thus if patients exhibited contraindications to drug administration then omission of the drug was counted as a correct withholding of the prescribed drug.

A separate analysis of all analgesic medications together showed that analgesic medication administration improved from 40% to 90% with the interventions described.

(See Table 4)

Discussion

The omission rate for analgesic medications following Caesarean sections in our hospital was greater than 60% when we measured it in the first audit. This was an alarming discovery in a routine audit of practice within the unit and compared very unfavourably with a 97% correct administration rate for non-analgesic medications in the same patients. This data contrasts with Leite and co-workers audit of 119 medication doses over a 5-day period in a Brazilian teaching hospital (120). Their study found

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an omission rate for medications of 21%, which is much lower than the omission rate for regular analgesic medications found in our initial audit.

This discrepancy may be partly explained by the fact that our study examined the administration of only one sub-group of medications, namely analgesics. The rate of administration of non-analgesic medications was much higher at our hospital at 97%. Combining the other medications with the routine analgesics would provide a higher figure for the overall delivery of prescribed medications. A check was also carried out to identify any other regular prescription medications being omitted in order to quantify medication administration rates for all prescribed drugs, particularly drugs other than analgesics. The major concern of the Acute Pain Service staff was the high rate for omission of prescribed regular analgesic medications. Additionally, the Leite study examined drug administration over 11 wards whereas our study was confined to one post-natal ward (120). A systemic review in 2013 by Berdot and co-workers examining drug administration errors identified drug omissions in approximately 6% of medication prescriptions, which is close to the level of medication omissions identified in our study for non-analgesic drugs, but is much lower than the 60% omission rate we identified for all analgesic drugs in our initial audit of analgesic delivery (131).

A high level of omission for prescribed analgesics was identified in a large Dutch teaching hospital by Boer and colleagues over 20 years ago (4). These workers showed that most patients received significantly less regular analgesia than they were prescribed, with as few as 4.2% of patients receiving their prescribed morphine dose, despite high visual analogue pain scores (4). These authors documented issues of time pressure, concerns about addiction and possible side effects as barriers to correct administration. We conducted a similar inquiry of the midwives at our hospital, who described a different set of barriers

(See Table 5)

Boer and colleagues recommended the introduction of an Acute Pain Service team to oversee postoperative analgesia and improve efficacy and quality of pain relief (4). Despite the presence of an active Acute Pain Service and clinical pharmacy service in our hospital these factors appeared to have had little impact on the low administration rate of regular pain medication.

Existing evidence in the literature specifically relating to obstetric analgesia supported the view that education and chart redesign can facilitate improved midwife compliance with novel care pathways that have been introduced to improve pain relief in labour. Buehner and colleagues found compliance with a new remifentanyl patient-controlled analgesia protocol increased from 10% to 91% following education and re-design of their chart (142). Although the improved administration of analgesia in both the Buehner study and our QI project could be attributed to the “Hawthorne effect”, of improved behavior when a workforce is being observed, it is an unlikely explanation in our project. This is because the midwives who were the subject of the drug administration audits, were completely unaware of the pre-intervention audit and also unaware of the timing of the post-intervention audit, which occurred 12 months after the initial audit identifying a low level of regular analgesic administration (153).

Medication omission can be a major problem in systemic healthcare error (164). Even where specific guidelines exist, such as cardiac care in acute coronary syndrome, prescription and delivery of guideline compliant care may not occur and a 10% decrease in guideline compliance can lead to a 10% increase in mortality (175). With respect to analgesia administration serious consequences of prolonged hospital stay and chronic pain syndromes following Caesarean section may be avoided by

appropriate compliance with guideline directed postoperative pain relief (3). Any methods of improving success in medication administration must be trialed by innovative health service professionals.

While electronic prescribing and medication administration systems might be capable of eliminating some of the omissions in delivery of regular analgesic medications such systems, incorporating automated reminders, have not been universally adopted. This is possibly because of mixed results following analysis of their introduction in limited ward environments (186). Where automated prescribing systems have been evaluated reductions in medication administration errors have occurred but timing and documentation errors were excluded from the analysis (197). There is still no fool-proof methodology for guaranteeing the administration of prescribed medications whether the prescription is electronic or paper-based.

One factor that our study did not review was postoperative pain scores for patients either before or after the intervention. While there is good evidence from systematic reviews that regular administration of multimodal analgesics provides improved pain scores and fewer complications after surgery this additional clinical information was not included in our study and would not be possible to obtain retrospectively (3). Future studies in this area could include additional measures of pain scores and complication rates (nausea and vomiting, hospital length of stay) to demonstrate the clinical benefit of Nudge theory in postoperative recovery.

The track record of innovation in encouraging optimal behaviour of trainees in the Department of Anaesthesia, Perioperative Medicine and Pain Management led us to adopt the recent development of "Nudge Theory" (2018). This concept has emerged from studies in behavioural economics to explain and drive improved decision making and can be employed in healthcare (8). A 'Nudge' is defined as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (109). The highlighting of the regular and 'as required' medications in the patient's chart represented a change in the choice architecture of medication prescription and administration that has predictably altered the behavior of the medical and nursing staff. A 'choice architect' is defined as someone who "has the responsibility for organizing the context in which people make decisions" (109). Consequently the acute pain team were acting as choice architects in organizing the context in which postoperative analgesia was prescribed and delivered. This is an example of using nudge theory to influence the behavior of clinicians for the manifest benefit of their patients (920).

We introduced the highlighting of important medications in the postoperative management of Caesarean section patients in order to draw attention to their importance and 'nudge' the treating healthcare professional into administering the correct medication, dose, frequency and timing. In this way we employed "choice architecture", as part of nudge theory, by highlighting the background colour of the analgesic medication prescription in the standard medication chart to nudge the treating clinician to make the correct decision with respect to administration of analgesic medications. This also made it easier for the health care professional to identify the analgesic prescription and give it in the correct dose and at the correct time (219).

This application of Nudge Theory was successful and raised analgesic medication administration rates from <40% to 89.9% when coupled with appropriate education. Prior work in palliative care at our institution had endorsed the use of pre-printed medication chart prescriptions provided a signature by a hospital medical officer confirmed the validity of the prescription (221).

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Tables**Table 1.****Statistically significant improvement in delivery of Paracetamol 1G 6-hourly after two interventions.**

Administered	Pre-intervention (n=96)	Post-intervention (n=99)
Yes	22 (22.9%)	85 (85.9%)
No	74 (77.1%)	14 (14.1%)

0.630, 95% CI 0.522 to 0.738, $z=8.84$, $p<0.001$ **Table 2.****Statistically significant improvement in delivery of Diclofenac 50mg 8-hourly after two interventions**

Administered	Pre-intervention (n=96)	Post-intervention (n=99)
Yes	31 (32.3%)	89 (89.9%)
No	65 (67.7%)	10 (10.1%)*

0.576, 95% CI 0.465 to 0.687, $z=8.27$, $p<0.001$.

* 3 of the non-administered in part 2 not prescribed as they were contraindicated

Table 3.**Statistically significant improvement in delivery of Oxycodone SR 10mg or 20mg 12-hourly after two interventions**

Administered	Pre-intervention (n=96)	Post-intervention (n=99)
Yes	61 (63.5%)	93 (93.9%)
No	35 (36.5%)	6 (6.1%)

0.304, 95% CI 0.197 to 0.411, $z=5.20$, $p<0.001$.**Table 4.****Statistically significant improvement in administration of Paracetamol, NSAID, and Oxycodone SR after two interventions**

Administered	Pre-intervention	Post-intervention
Yes	114 (39.6%)	261 (89.9%)
No	174 (60.4%)	36 (12.1%)

0.503, 95% CI 0.437 to 0.569, $z=12.8$, $p<0.001$.

Table 5.

Reasons given by midwives for not administering regular analgesia as prescribed

<ul style="list-style-type: none">• Emergency caesarean section after hours
<ul style="list-style-type: none">• Midwives uncertain about appropriate dose intervals, or when to give the next dose of each medication
<ul style="list-style-type: none">• Dose times were not written onto the inpatient medication chart by the prescriber
<ul style="list-style-type: none">• Medication administration was at times seen as a low priority
<ul style="list-style-type: none">• Patient sleeping
<ul style="list-style-type: none">• Patient off the ward
<ul style="list-style-type: none">• Patient attending to newborn (e.g. feeding, bathing)
<ul style="list-style-type: none">• Patient visiting newborn in Special Care Nursery

Figure Legends

Figure 1.

The revised medication chart showing use of choice architecture to highlight important postoperative medication

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