

Patient Safety Update: Central Neuraxial Blockade, Drug Errors and 'Never Events'

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QUESTIONS

Before continuing, try to answer the following questions. The answers can be found at the end of the article, together with an explanation. Please answer True or False:

1. Regarding safe central neuraxial blockade:

- a. Meningitis is a rare but well-recognised complication of spinal anaesthesia
- b. Chlorhexidine in alcohol is the best solution to use for skin antisepsis prior to performing a central neuraxial block
- c. Barrier precautions for performing an aseptic CNB include hand-washing, wearing a hat, mask, sterile gloves and gown, and using a sterile drape
- d. There is no need for the operator to wear a face-mask if they are just performing a spinal injection
- e. Spinal anaesthesia should be avoided in a patient with known bacteraemia

2. Concerning drug errors:

- a. Rapid bolus administration of vancomycin, magnesium or amiodarone can lead to severe hypotension or cardiac arrest
- b. Good anaesthetists rarely make a drug error
- c. Retained anaesthesia drugs in IV lines are only a risk in paediatric practice
- d. Dangerous drugs such as concentrated potassium should be stored separately in the operating theatre
- e. Syringe swaps are an important cause of awareness with awake paralysis

3. Concerning 'never events':

- a. Never events are unfortunate, but have no reflection on the overall safety culture of the organisation
- b. Surgical events rarely feature in descriptions of never events on a national scale
- c. A 'never event' usually happens because one person doesn't do their job properly
- d. The most reliable way to prevent a surgical never event is the time out check immediately prior to skin incision
- e. All patients should have the surgical site marked if feasible, and the mark should remain visible under the surgical drapes.

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KEY POINTS

- Meningitis is a very rare but recognised complication of central neuraxial blockade, and is minimised by strict aseptic technique
- Drug errors are common in anaesthesia practice. It is our responsibility to adopt safety measures in our daily practice and to comply with standard safety procedures
- 'Surgical' never events - wrong site surgery, retained foreign object, wrong prosthesis- are the most common category of never event in clinical practice, which usually occur as a result of a cascade of errors. Standardisation of operating department procedures may be an effective way to reduce surgical never events.

INTRODUCTION

This tutorial is based on the Patient Safety Update published by the Safe Anaesthesia Liaison Group (SALG). SALG is a professional group with a core membership including representatives from the Royal College of Anaesthetists (RCOA), the Association of Anaesthetists of Great Britain & Ireland (AAGBI), and NHS England Patient Safety. SALG's quarterly Patient Safety Updates contain learning from incidents reported to the National Health Service England and Wales National Reporting and Learning System (NRLS). The aim of SALG is to highlight potential or existing patient safety issues from patient stories, and to encourage incident reporting for the purpose of learning.

Cases reported to the NRLS database that are associated with severe harm or death are reviewed on a quarterly basis and form the basis of the SALG PSU. The text is changed very little from the reports of the clinicians involved – these are real stories. There are often common themes within the cases that influence the learning points highlighted. The aim of this exercise is to learn from the experience of others, and in that way we can all improve the care of our patients.

The cases reported are reproduced with permission from the Safe Anaesthesia Liaison Group, and were originally published on the Royal College of Anaesthetists and the Association of Anaesthetists of Great Britain and Ireland websites. Further information, together with this and previous Patient Safety Updates, is available on the SALG website.¹

The cases and much of the information contained in this tutorial is taken from the SALG Patient Safety Updates July-September 2016. SALG has not reviewed this publication.

CENTRAL NEURAXIAL BLOCKADE

Meningitis is a rare but well-recognised complication of CNB, occurring in <1:200,000 cases. The Royal College of Anaesthetists' third national audit project (NAP3) summarises the risks associated with epidural or spinal central neuraxial blockade (CNB), including the risk of meningitis.²

Nasopharyngeal commensals are the most common causative bacteria for meningitis after spinal anaesthesia, suggesting that the cause is droplet contamination of the spinal needle by the operator. Culture of *Strep. Salivarius* in this case is in keeping with droplet spread from the operator's airway.³ The most common causative agent in epidural anaesthesia is a skin commensal, suggesting suboptimal aseptic technique, also an important cause of epidural abscess.²

Risk factors for development of meningitis after CNB

Patient risk factors:

- Immune compromise
- Prolonged insertion of a catheter.

Endogenous source of infection

- Local skin sepsis
- Systemic sepsis

Exogenous source of infection

- Contaminated equipment
- Contaminated solutions

Case Report

'The patient had a spinal anaesthetic and had a polyp removed in theatre. The patient returned 2 days later for brachytherapy (radiotherapy), and had a repeat spinal anaesthetic... discharged later that day. The patient was rushed to Accident & Emergency in the early hours of the morning and ended up in ITU, intubated with suspected sepsis. Discharged 13 days later.

Reason stated for collapse was cerebromeningoencephalitis with *Strep. Salivarius* bacteraemia from the spinal anaesthetic.'

Full aseptic technique is recommended during preparation and siting of CNB. The Association of Anaesthetists of Great Britain & Ireland (AAGBI) and American Society of Anaesthesiologists (ASA) both recommend the use of a surgical facemask by the operator during spinal anaesthesia.^{4,5}

The evidence-based practice advisory from the ASA highlights the prevention, diagnosis and management of infective complications from CNB. There are few high-level studies, so most evidence is from observational studies and case reports, with recommendations based on expert consensus opinion.⁵ The ASA Practice advisory makes the following recommendations:

- Consider risks and benefits of CNB on a case-by-case basis, and consider an alternative approach in patients at high-risk of an infective complication (for instance, impaired immunity)
- Avoid lumbar puncture in the presence of a known epidural abscess.
- Consider pre-procedure antibiotics in patients with known or suspected to have on-going bacteraemia
- An aseptic technique must be used for all CNB insertions:
 - Sterile equipment must be used (e.g. needles, catheters, ultrasound cover)
 - Operator to wear surgical cap and face-mask to cover mouth and nose
 - Remove jewellery (rings, watches)
 - Wash hands
 - Use sterile gloves
 - Chlorhexidine in alcohol is recommended for skin preparation with adequate drying time
 - Use a sterile occlusive dressing at the catheter insertion site.

Chlorhexidine in alcohol is an effective skin antiseptic, but there are concerns about chemical arachnoiditis if the intrathecal space is contaminated with chlorhexidine, for instance by splashing chlorhexidine on the spinal needle. For this reason, the AAGBI recommends using low concentration chlorhexidine (0.5%) in alcohol for skin antiseptics prior to performing CNB, with meticulous care taken to avoid chlorhexidine from reaching the CSF⁴. Open containers containing chlorhexidine must NOT be placed on the spinal trolley.

Case Reports

'A trainee anaesthetist changed the propofol syringe whilst the Consultant Anaesthetist took a comfort break and forgot to restart the machine. The infusion pump failed to give an audible alarm and the anaesthetic levels were not maintained, which was only discovered when the patient moved on the operating table.'

'Just before knife to skin for insertion of haemodialysis access graft, I gave vancomycin intravenously over one minute instead of over 60 minutes as advised. It had been a year since I had last given vancomycin IV and I simply forgot that it could not be given as a bolus. The patient became red, hypotensive (40/20 initially responding to adrenaline). I knew immediately what I had done, corrected it, and surgery proceeded uneventfully. I explained

everything and apologised to the patient as per duty of candour an hour or two postop. I thought there had been no sequelae as she was fine at the time. Unfortunately the patient developed new neurological symptoms after the operation.'

'A patient was admitted to recovery. The 20G cannula used for induction with remifentanyl and propofol at the start of a case had not been flushed along with the other cannula during the case. We were aware that there was a risk of opioid remaining in the cannula so the cannula was flushed by the anaesthetist. The patient stopped responding and required assisted ventilation for 30 seconds.'

DRUG ERRORS

Drug errors are one of the most common types of error reported to the NRLS and can arise for many reasons, including slips (failure of attention) and lapses (failure of memory), as in the cases described here. The fifth Royal College of Anaesthetists' national audit project (NAP5), 'Accidental Awareness During Anaesthesia in the United Kingdom and Ireland' found that syringe swaps and other drug errors accounted for 1 in 8 of all definite and probable cases of awareness reported to the audit.⁶

Vancomycin, clindamicin and levofloxacin are antibiotic drugs known to lead to hypotension and even cardiac arrest when given as a bolus. Vancomycin is a well-recognised cause of 'red man syndrome' due to histamine release after rapid IV administration. Rapid administration of amiodarone, phenytoin, magnesium, and hypertonic solutions of mannitol and saline may also cause hypotension, which can be severe.⁷ Residual anaesthesia drug in IV lines is another drug error that has recently attracted attention; it is the responsibility of the anaesthetist to flush all IV lines at the end of each case.⁸

Anaesthetists are in the unique position in medicine of prescribing, drawing up and administering multiple different drugs during a case, often in rapid succession, often in situations where there may be many other distractions. Drug errors and near misses are common in anaesthesia, estimated to occur in 1:133 -1:450 anaesthetics. Based in these data, the average anaesthetist could be expected to make up to seven drug errors per year, and possibly two drug errors resulting in serious harm to the patient during a career in anaesthesia. The majority of drug errors are due to human error and preventable, so it is obvious that we all need to put measures into place to reduce our drug errors⁹⁻¹¹.

The **most common** types of drug error in anaesthesia are⁹⁻¹¹:

- Incorrect dose (miscalculation, concentration or infusion rate)
- Substitution (syringe swap)
- Repetition (extra dose)
- Omission (missed dose)

Uncommon potentially lethal drug errors include:

- Wrong route errors (e.g. IV/epidural/intrathecal wrong route errors)
- Miscalculation of dilution (or failure to dilute)
- Mis-programming of infusion pumps
- Administering a drug to a patient with a known allergy
- Failure to flush a line after a drug has been administered

Stabile *et al.* published a very informative article concerning medication safety in a USA Anaesthesia Patient Safety Foundation (APSF) newsletter.¹¹ The APSF is an international campaigning organisation aimed at anaesthesia safety research and education (<http://www.apsf.org>). They have also developed a video to support the APSF advice concerning medication safety (<http://www.apsf.org/resources/med-safety/watch>).

The following practices have been recommended to reduce drug administration errors⁹⁻¹¹:

- Label all syringes, and discard unlabelled syringes
- Read the label on any drug ampoule or syringe before a drug is drawn up or injected
- Standardise syringe labels in your theatres/operating rooms, and use class-specific colour codes according to international ISO standards (or a bar-coding system)
- Organise your workplace - keep your workspace tidy, use standardised drug trays, separate similar or dangerous drugs, and remove dangerous drugs from the operating theatre.
- Double check medications, particularly high-risk medications, prior to administration, ideally with a second person, or using bar-coding technology
- Use pre-filled syringes where possible
- Cover all syringes with caps to maintain sterility
- Use standardised 'smart' syringe pumps in your theatre/operating room, with pre-set alerts and alarms
- Use labelled 'route specific' administration sets (e.g. IV or epidural), with colour codes (yellow epidural, red arterial), and remove injection ports e.g. from epidural lines.
- Include a review of drugs administered in your handover checks
- Discard all unused drugs at the end of each case
- Flush all IV lines at the end of the case, before handing the patient over to recovery

All theatres/operating rooms should have dedicated support from the hospital pharmacy, including support for purchase and restocking of drugs. Purchase of look-alike drugs should be avoided, or if this is unavoidable, the anaesthesia team should be alerted to the existence of look-like drugs, also to any change in appearance or concentration of commonly used drugs. Rarely used drugs and solutions (e.g. glucose, heparin, hypertonic saline, sterile water, epidural solutions) should be stored separately from routinely used IV solutions.

We should all aim to develop a culture of respect and compliance relating to patient safety, with written policies for medication safety,

appropriate induction for new staff, and teaching and supervision of junior staff. Senior leadership is an important factor in achieving this.

SURGICAL NEVER EVENTS

Case Report

'Patient being operated on in the prone position...despite the WHO checklist the patient was shaved and then underwent an incision on the wrong hip... once recognised the wound was closed and surgery was performed on the correct hip.'

There are some things that should never happen in health care, particularly operation on the wrong site.

In the NHS, a 'Never Event' is defined as 'a serious incident that is wholly preventable as guidance or safety recommendations that provide strong systemic protective barriers are available at a national level and should have been implemented by all healthcare providers.'

Never events are unambiguous, serious events, usually preventable, and are thought to be indicative of a problem in the health system.

Mandatory reporting is required, with root cause analysis conducted for each incident in a proscribed time frame and dissemination of learning within the organisation and more widely. There may also be financial implications for the institution or individual clinician in some healthcare settings.

Unfortunately, the most common never events in NHS practice are 'surgical' never events: wrong site surgery, retained foreign object post procedure, wrong implant/prosthesis.

Evidence suggests that never events in surgery generally occur as a result of a 'cascade' of errors, such as:¹²

- Scheduling errors
- Incorrect consent
- Incorrect patient information
- Failure of the time out procedures
- Incorrect marking procedure
- Wrong site anaesthetic block
- Confusion due to prone position or incorrect positioning/application of a tourniquet
- Multiple procedures on the same patient
- Incorrectly labelled specimen

Other contributing factors to surgical never events have been described:^{13,14}

- Failure to follow standard procedures, bending or breaking the rules

- Human factors
- Chaotic workplace, rushing, interruptions
- Complexity of the case, perceived emergency
- Communication failures
- Lack of training
- Confirmation bias
- Channelled attention
- Over confidence
- Lack of vigilance
- Failure to understand barriers
- Inconsistent practices between teams
- Staff unable to speak up

In 2014 NHS England commissioned a Never Events Task Force to address the problem of continuing surgical never events in the NHS (<https://www.england.nhs.uk/patientsafety/never-events/surgical/>). The task force recommended improved education for theatre staff to understand the evolution of never events, the adoption of 'standard operating procedures' for operating practice, and consistent reporting, dissemination and learning from never events. The National Standards for Invasive Procedures (NatSSIPS) were published in 2015 (<https://www.england.nhs.uk/patientsafety/neverevents/natssips/>), with a requirement for all NHS organisations to translate these national standards into local standard operating procedures.

With respect to wrong site surgery, the least reliable safety check is at the time out immediately prior to skin incision as 'confirmation bias' is very common. The most effective way to catch a wrong site error is for the surgeon to assess and mark the patient preoperatively, with repeat checks at multiple points. Relevant to the case described here, the procedural verification NatSSIP recommends:

For procedures during which the patient's position may be changed, marking must be applied such that it is visible at all times. When the patient's position is changed during a procedure, the surgical site should be reverified and the surgical mark checked.

The latest data from NHS Improvement for 2016/17 includes 380 never events, 78% of these surgical, including 156 wrong site surgeries, 95 retained foreign objects post procedure, and 45 wrong implant/prosthesis. This is a slight improvement on the 2015/16 data – rather too soon to say, but maybe indicates that standardisation of our operating procedures could be a way to reduce the incidence of surgical never events.¹⁵

SUMMARY

All anaesthetists should be encouraged to develop a culture of incident reporting and analysis. The anaesthetists involved in the cases reported here are to be commended. In the words of Mackintosh:¹⁶

'It is difficult enough to overcome the inertia natural to most of us to write to the medical journals about our successes. Believe me, it takes considerable effort to prepare a communication about one's failures.'

'A wise man learns from his mistakes, and I hope that we can go a step further and learn from the mistakes of the other man.'

Strict asepsis is important when undertaking CNB. Drug errors are common in anaesthesia practice, and can be reduced by careful arrangement of the workspace, adoption of routine safety procedures such as labelling, checking, and use of prefilled/pre-diluted medications, with separation of 'dangerous' drugs from commonly used drugs. All IV lines should be flushed at the end of surgery prior to transfer to recovery area. Standardisation of operating room procedures and an understanding of why never events occur may be an opportunity to reduce serious incidents in surgical practice.

ANSWERS TO QUESTIONS

1. Regarding safe central neuraxial blockade:

- True: NAP3 estimated the incidence of meningitis as a complication of CNB as fewer than 1:200,000
- True: Chlorhexidine in alcohol is an effective antiseptic. The AAGBI guidelines recommend a 0.5% chlorhexidine solution as sufficient for antiseptics and less likely to cause neurotoxicity
- True: These are the barrier precautions recommended by the AAGBI and the ASA guidelines
- False: Nasopharyngeal commensals are the most common causative bacteria for meningitis after spinal anaesthesia, suggesting that the cause is droplet contamination of the spinal needle by the operator
- True: ASA guidelines recommend that for patients at high risk of infectious complications, alternatives to neuraxial techniques should be considered, but that the decision whether or not to use a neuraxial technique should be made on a case-by-case basis. The guidelines recommend that antibiotics should be given before CNB when the patient has a known or suspected bacteraemia.

2. Concerning drug errors:

- True: Rapid bolus injection of these drugs has been associated with hypotension and cardiovascular collapse
- False: Drug errors are common in anaesthesia and the average anaesthetist is likely to make up to seven errors per year.
- False: IV anaesthetic agents cause harm if not flushed after IV administration in any patient. This is particularly true for potent agents such as remifentanyl.
- True: dangerous drugs such as concentrated potassium should be separated from routine IV drugs, and should be stored separately.

- e. True: Syringe swaps and other drug errors accounted for 1 in 8 of all definite and probable cases of awareness reported to NAP5

3. Regarding 'never events':

- a. False: The occurrence of a never event may reflect an underlying problem in the health system
- b. False: In the NHS, surgical never events are the most common category of never event
- c. False: A never event usually occurs due to a cascade of errors involving multiple individuals
- d. False: the most reliable way to prevent a surgical never event is for the surgeon to assess the patient preoperatively and to mark the patient, and for the surgical site to be rechecked at multiple points.
- e. True: All patients should have the surgical site marked if feasible, and the mark should remain visible under the surgical drapes.

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