Avoidable, Delayed and Under or Overtransfusion (ADU) Case Studies

Prothrombin Complex Concentrate (PCC)

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Slow reversal of Warfarin with PCC associated with increased intracranial haemorrhage (ICH) and death (imputability 1 – possible)

- *A patient who was on Warfarin for a previous deep vein thrombosis suffered an assault resulting in head injury*
- *A computed tomography (CT) scan of the head was done within an hour of admission when the patient was fully alert*
- *This showed ICH and vitamin K was given 3 hours after the CT report*
- *The patient sneezed just after this with a rapid deterioration in Glasgow Coma Scale*
- *PCC was prescribed 30 minutes later and given an hour after the sneeze*
- *This was 4 hours after the CT report*
- *Repeat CT confirmed extension of the ICH and 9 hours after admission, the patient became unresponsive*
- *They were transferred to a neurosurgery unit but died from the ICH*
- *The delay in treatment with PCC was considered to have possibly led to the patient death*

Delayed treatment with PCC after injury resulted in a prolonged stay in the intensive care unit (ICU)

- *An elderly patient on warfarin attended a very busy emergency department after a fall in the shower sustaining a head injury*
- *Blood tests showed a high international normalised ratio of 12.0 and vitamin K was given*
- *Imaging showed peritoneal haematoma related to a fractured vertebra with a damaged blood vessel*
- *Interventional radiology (IR) was planned to treat this*
- *However, due to confusion, lack of understanding among staff and poor communication, there was a delay of at least 15 hours before PCC was requested, delaying the IR procedure*
- *Had the PCC been given sooner, this delay may not have occurred, and it is possible that admission to ICU would not have been required*
- *The patient was in ICU then the high dependency unit for a total of 2 weeks*

Failure to reverse warfarin and inadequate red cell transfusion

- *An elderly person was admitted with a suspected cerebrovascular accident which was not confirmed on computed tomography*
- *However, they were found to have a haemoglobin of 44g/L and very high international normalised ratio (INR) (confirmed on repeat testing)*
- *The patient received a single unit of red cells but no reversal of the high INR*
- *They had epistaxis earlier in the day but no other bleeding*
- *No bleeding source was sought*
- *The patient collapsed and died 15 hours after admission*
- *The patient was on an acute ward which was very short staffed and usually relied on bank and agency staff*

Failure to administer prothrombin complex concentrate (PCC) to an elderly man with intracranial haemorrhage

- *A request was made from the emergency department (ED) to the transfusion laboratory to issue PCC 1000IU to reverse warfarin for a patient with an acute subdural haematoma resulting from a fall*
- *PCC was issued at 00:58 but never collected*
- *At 12:25 the PCC was returned to stock by the transfusion laboratory*
- *A verbal handover in the ED stated that the patient had received the PCC and was also documented wrongly in the patient notes*
- *Failure to give PCC was considered contributory to his death*

Failure to give prothrombin complex concentrate (PCC) for intracranial haemorrhage (ICH) due to misunderstanding of a new information technology system

- *An elderly man on edoxaban for atrial fibrillation presented to the emergency department (ED) with a history of a fall at home*
- *He sustained another fall in a cubicle in the ED hitting his head*
- *A computed tomography scan of his brain demonstrated ICH*
- *PCC was prescribed on the new electronic patient record system (which had only been in use for a month) at 17:56 however the request was not automatically received in the laboratory*
- *PCC was not issued until nearly 4 hours later at 21:39 when the laboratory was contacted by telephone*
- *This delay was considered contributory to the patient's death*

Life-threatening delay in administration of prothrombin complex concentrate (PCC) for gastrointestinal haemorrhage

- *A woman in her 50s on warfarin (metallic heart valves) presented to the emergency department with melaena and a haemoglobin of 48g/L*
- *PCC was authorised by the on-call haematologist at 06:30 but not requested until much later, at 17:55*
- *The patient was topped up with red cells but failed to receive PCC as the international normalised ratio (INR) result was delayed (coagulation analyser recorded INR as >10 but was recorded on laboratory information management system as 'unable to analyse' in error)*
- *She developed haemodynamic instability requiring transfer to intensive care unit for inotropic support*
- *Endoscopy was eventually done at 02:00*

Incomplete dose of prothrombin complex concentrate (PCC) given without prescription for a patient with intracranial haemorrhage (ICH)

- *A dose of 3000IU PCC was advised by the consultant haematologist for a patient with ICH; this correct dose was issued from the transfusion laboratory*
- *At 21:58 the nursing notes documented that 3000IU had been given, but only 2000IU was given and not correctly recorded by an agency nurse working in a busy emergency department (ED)*
- *The patient was admitted to the intensive care unit and made a full recovery*
- *A vial of 1000IU PCC was returned to laboratory from ED 12 days after issue*

Delayed prothrombin complex concentrate (PCC) administration for intracranial haemorrhage (ICH)

- *A man in his 70s on anticoagulants for atrial fibrillation and with left sided weakness arrived in the emergency department (ED) at 02:01*
- *At 07:15 it was noted that the patient had a long wait in ED*
- *A computed tomography scan showed ICH*
- *At 10:40 the haematology registrar advised PCC which was issued, but not administered until 2 hours later, 11 hours after admission*
- *There were delays in the prescribing, ordering, collection, and administration of the drug due to lack of knowledge (new nurse and agency nurse looking after the patient)*

Delay in adequate reversal of anticoagulation following pelvic fracture

- *An elderly lady fell sustaining a fracture of her pelvis*
- *She was on warfarin for atrial fibrillation and was admitted at 05:55*
- *Scanning suggested active bleeding and at 08:21 the major haemorrhage protocol was activated; a haematology registrar advised an inappropriately low dose of prothrombin complex concentrate (PCC) (15IU/kg)*
- *A corrected dose of 50IU/kg was given 3 hours later*
- *Death was not thought related to the suboptimal first PCC dose*

Delay in treatment of intracranial haemorrhage due to prothrombin complex concentrate (PCC) request made for wrong patient

- *PCC was ordered using the wrong patient's demographics and resulted in a delay of 3 hours before PCC was requested for the correct patient*
- *The wrong case notes were selected by a doctor who was unfamiliar with the ward*
- *The correct case notes were in the X-ray department where the patient had been for a scan*

Delayed administration of prothrombin complex concentrate (PCC) in a man with intracranial haemorrhage (ICH)

- *An elderly man admitted the previous evening with a raised international normalised ratio and had ICH identified on a computed tomography scan*
- *A decision was made to reverse warfarin at 09:00, and a request sent at 09:25*
- *The PCC was issued, and porters contacted at 09:40, collected at 11:07, and given at 12:10, more than 12 hours from admission*
- *The emergency department was very busy and poorly staffed*
- *The patient died 16 days later unrelated to the delay*

Inappropriate and delayed administration of prothrombin complex concentrate (PCC)

- *An elderly woman on apixaban experienced a small rectal bleed*
- *PCC was requested at 20:35 but not collected until 03:30*
- *It was then given over 9 hours instead of 40 minutes*
- *This treatment was not necessary as well as being delayed*
- *There was a lack of knowledge about PCC in medical and nursing staff*

Underdose of prothrombin complex concentrate (PCC) treatment due to lack of adequate stock

- *A man in his 60s was admitted to the emergency department with new right sided weakness*
- *He had atrial fibrillation and was anticoagulated with apixaban*
- *A computed tomography scan demonstrated intracranial haemorrhage*
- *Haematology staff recommended 2000IU of PCC from the transfusion laboratory in accordance with the organisations guideline for treating major haemorrhage in patients taking direct acting oral anticoagulants*
- *However, only 500IU of PCC were available with another 1000IU transferred from a linked hospital, so the patient ultimately received a total of 1500IU*

Delayed and underdosing of prothrombin complex concentrate (PCC) for intracranial haemorrhage treatment due to lack of adequate stock

- *An elderly woman with suspected subarachnoid haemorrhage was recommended to receive 3000IU PCC to reverse anticoagulation at 17:06*
- *This was collected from the transfusion laboratory at 17:45, but administration of 1500IU was not finished until 05:00 the next day*
- *There was no documentation of the start time*
- *The full dose was not given*
- *The remaining three vials were not found until a week later*
- *Staff infrequently used PCC, and did not appear fully aware of its indications and the requirement to be given promptly*

Delay in treatment of intracranial haemorrhage (ICH)

- *An elderly woman with ICH had a 2-hour delay in prothrombin complex concentrate administration due to poor communication*
- *It was not clear if this would have changed the outcome*
- *She deteriorated and died*

Prothrombin complex concentrate (PCC) delay because of need to weigh the patient

- *A woman in her 80s on Apixaban for atrial fibrillation (AF), with upper gastrointestinal (GI) bleeding was in the emergency department (ED) and received red cells*
- *Confusion was caused by the requirement for her weight, and she was not well enough to get off the trolley*
- *This hospital had a fixed dose policy but shared on call haematology staff with another NHS organisation who use a weight-based dose*
- *It was not clear if she received the dose but was put on an end-of-life pathway and died unrelated to the PCC issues*

Difficulties in accessing prothrombin complex concentrate (PCC) resulting in delayed administration and extension of intracranial haemorrhage (ICH)

- *An elderly patient on Apixaban presented to the emergency department (ED) following trauma with a head injury at 17:31*
- *The report of a head computed tomography (CT) at 22:25 showed ICH*
- *PCC was requested*
- *On this site the transfusion laboratory was shut after midnight, so PCC was kept in the emergency drugs cupboard with access restricted to the site manager and pharmacists*
- *The PCC could not be found in the emergency drugs cupboard*
- *The on-call pharmacist was contacted who recommended discussion with the transfusion laboratory at the main site*
- *The main site biomedical scientist (BMS) offered to transport the PCC but to prevent further delay the clinician chose to transfer the patient to the main site where PCC was issued (06:42)*
- *A repeat CT scan the next day showed extension of ICH*

Off licence use of prothrombin complex concentrate (PCC)

- *A teenager was very unwell and admitted to the intensive care unit with an initial diagnosis of acute promyelocytic leukaemia (APML)*
- *The patient had coagulation disturbances and was prescribed PCC 3000IU but received 1000IU*
- *Fresh frozen plasma (FFP), platelets and cryoprecipitate were also given which were appropriate for acute myeloid leukaemia (AML) with coagulopathy, however there is no literature to suggest PCC is indicated or appropriate in this setting*

Long delay in treatment for intracranial haemorrhage (ICH) with staffing and communication issues

- *A patient on Warfarin presented with frontal ICH*
- *Computed tomography (CT) confirmed this diagnosis 21 hours after admission*
- *After rapid discussion with the haematologist at 17:00, prothrombin complex concentrate (PCC) was requested and issued at 17:40*
- *This plan was not communicated to the ward staff until 21:00*
- *The ward was very busy and short-staffed with many sick patients*
- *The need for additional staff was escalated without success*
- *The patient was difficult to cannulate, and the PCC was given at 01:50 the next morning (about 8 hours from the decision) and with a slow rate as 1500IU took over 1 hour and 50 minutes to administer*

Three cases of suspected intracranial haemorrhage (ICH) with delayed infusion

1. *In a patient on warfarin with a head injury, there was a 4-hour delay while the patient was moved between departments and the prescription was lost*

2. *Following a head injury in a patient on apixaban for atrial fibrillation the infusion was set to run at 1mL/hour instead of 1mL/minute. This was recognised after running for 16 hours*

3. *A man in his 80s with suspected ICH had delayed administration because each vial was collected separately from the transfusion laboratory rather than all collected together*

An asymptomatic patient with very high international normalised ratio (INR) received prothrombin complex concentrate (PCC)

- *An elderly lady with no bleeding but a history of falls was on warfarin for atrial fibrillation*
- *Her INR was very high, 16.2, and she received vitamin K and 3000IU of PCC as an outpatient as prophylaxis on the advice of the Patient at Home team*

Delay to administration of prothrombin complex concentrate (PCC) contributes to a patient's death

- *An elderly lady on warfarin fell and broke her arm*
- *She was admitted and later developed a spontaneous intracerebral haemorrhage, possibly as a result of hypertension*
- *The anticoagulation was immediately reversed with vitamin K and PCC was advised*
- *The doctor 'prescribed' PCC using the electronic patient record system but in fact this was an order to the blood bank, not a prescription*
- *The PCC was issued immediately but not collected or administered for another 5 hours*
- *The patient died 5 days after admission*
- *Changes have been made to the IT system to make sure it is clear to clinical staff that an order and a prescription need to be completed separately*

Prothrombin complex concentrate (PCC) given at an inappropriate rate due to lack of knowledge

- *Treatment was indicated for insertion of a chest drain in a patient with a haemothorax*
- *PCC was started at the wrong rate of 8mL/hour instead of 8mL/minute*
- *The prescribing doctor did not state a rate and was not competent to administer it*
- *This was a fraught situation including cardiac arrest during the transfusion*
- *As a result, further training was provided in the emergency department (ED) and there was discussion with all staff involved*

Inadequate dose required urgently for intracranial haemorrhage

- *Urgent treatment was required for an elderly patient on warfarin, international normalised ratio (INR) 3.5, with intracranial haemorrhage*
- *This site only had 500IU in stock and there was a delay in obtaining the rest of the 1500IU from another site resulting in delay of 1.5 hours*
- *Although stock checks had taken place the staff had not ensured further supplies were ordered*
- *The procedures have been tightened up*

Treatment delay due to lack of knowledge

- *Emergency surgery for a perforated ulcer was delayed because the ward staff were unclear how to obtain and administer prothrombin complex concentrate (PCC)*
- *Training needs were identified and have been resolved*

Confusion over similar trade names results in wrong product transfusion

- *An elderly man was admitted with gastrointestinal bleeding*
- *There was confusion over similar blood component/product names*
- *The patient was admitted with bleeding needing warfarin reversal*
- *The patient also received emergency group O D-negative red cells (three), and platelets*
- *Octaplas® (solvent-detergent fresh frozen plasma (SD-FFP)) was requested verbally without informing the laboratory staff about the need for warfarin reversal, and five units of Octaplas® were issued after 2 hours waiting for the correct documentation*
- *Three units were transfused before the written request clarified what was required, and Octaplex® (PCC) issued with a delay of 3.5 hours for treatment*
- *The laboratory biomedical scientist (BMS) agreed they should not have released the product without written confirmation*

PCC algorithms should state maximum dosage

- *A woman in her 40s, weight 138kg, with a retroperitoneal haematoma was prescribed (by a foundation year 2 doctor) and given a PCC dose in the ED based on her weight (4140 units) which exceeded the maximum recommended dose of 3000 units for that particular PCC*
- *This resulted in revision of the PCC algorithm to add the maximum dose and a notice was added to the refrigerator in transfusion to ensure more than the maximum dose could not be issued*

Guidelines are not rules

- *A woman in her 70s who was very unwell with INR 1.3 required an urgent laparotomy for bowel resection*
- *She was on warfarin for atrial fibrillation and had a previous pulmonary embolism*
- *She had initial surgery some days earlier and had been restarted on warfarin*
- *The consultant anaesthetist refused to take her to theatre without PCC; 500 units were authorised by a consultant haematologist*
- *This was against hospital and anaesthetic policy for the management of INR results, but the anaesthetist had good reasons for giving the PCC on this occasion*

FFP should not be used to reverse warfarin

- *A woman in her 70s who was on warfarin for atrial fibrillation (INR 3.7) developed a rectus sheath haematoma*
- *FFP (two units) was given for warfarin reversal instead of PCC*
- *These were prescribed by a surgical registrar*
- *The patient had a mild allergic reaction*
- *As a result of this case, the PCC pathway was made more accessible to clinical staff*

Read the results carefully

- *A man in his 80s on warfarin for bilateral pulmonary emboli, was admitted with abdominal pain and distension*
- *He was treated with PCC (3000 units) based on an erroneous blood result reported from a point-of-care test where the doctor misread the result (reporting that the Hb had fallen from 145g/L to 45, but this was the %; actual Hb was 90-102g/L)*
- *The patient had already received vitamin K*

Consider the timing carefully

- *A man in his 60s on warfarin received PCC in advance of a renal transplant, but the interval between admission and transplant was sufficient that the INR was corrected to 1.2 by vitamin K and stopping the warfarin so the PCC was unnecessary*

Delay in administration of PCC to a patient with intracranial haemorrhage (ICH) Case 1

- *A man in his 70s on warfarin had ICH confirmed on a CT scan performed at 20:26*
- *PCC was requested at 22:15 but not issued until 23:06; collected by the ward at 23:50 and given at 00:05, a delay of about 3.5 hours*
- *The INR was repeated at 01:00 and recorded as 1.4*
- *The laboratory standard operating procedure (SOP) has been revised*

Delay in administration of PCC to a patient with ICH - Case 2

- *An elderly man on warfarin suffered a fall resulting in an ICH (INR 2.8)*
- *He was prescribed 3000IU of PCC but only 1000IU was given initially*
- *Further stock was obtained from another hospital and given 4.5 hours later*
- *He recovered and survived*
- *The PCC stock had not been re-ordered when getting low*
- *As a result of this incident the base stock level was increased and an increased number of staff were authorised to reorder it*

Communication issues cause delay in release of PCC

- *A patient was in theatre for a heart transplant*
- *The consultant anaesthetist requested PCC for emergency reversal of warfarin. The BMS on duty asked that this be authorised by the haematology registrar. This registrar cover is provided by another organisation, which often results in delays in communication*
- *The request for PCC was appropriate, and according to the laboratory SOP, authorisation by a haematology doctor was not required*
- *Thus the PCC should have been issued in a matter of minutes, but as a result of delays trying to make contact with the haematology team the issue was delayed by 30 minutes*
- *The BMS on duty was relatively new to the department, having previously worked in an organisation which required authorisation of PCC by the haematology team*

Administration of PCC to the wrong patient

- *A request form for PCC was completed for the wrong patient*
- *The product was issued by the laboratory for the patient on the request form but was given to a different patient (who was the intended recipient) by the anaesthetist despite all paperwork and labels having details for the patient on the request form*

Misunderstanding of the indications for and use of PCC

- *A lady in her 60s was readmitted via the ED 7 days after total abdominal hysterectomy and salpingo-oophorectomy for malignancy . She had developed postoperative pulmonary embolism and was on warfarin for this*
- *PCC 2750IU was given prior to surgery (for a second look) to reverse the warfarin which was stopped and postoperatively she was treated with low molecular weight heparin*
- *The following day a junior doctor requested further PCC and was informed by laboratory staff that the patient had had a dose the day before to reverse the warfarin*
- *The doctor stated he had discussed it with the haematologist who agreed*
- *A dose of 3000IU PCC was collected but 5 days later was found in the patient's drawer*
- *The transfusion practitioner discussed the incident with the consultant haematologist who stated he was not informed of the full facts*