

VITAMIN K DEFICIENCY: A CASE STUDY



Alison Hadfield, a Healthcare Science Section Leader in core haematology from the Newcastle upon Tyne Hospitals NHS Foundation Trust, presents a vitamin K-deficiency patient case study.

Bloods were received into the laboratory of a 73-year-old male about to have a re-do of an aortic valve replacement. Coagulation screen results showed a prolonged prothrombin time (PT) of 111 seconds (NR=10-13 seconds) and a prolonged activated partial thromboplastin time (APTT) of 109 seconds (NR=27-39 seconds) with a normal fibrinogen. The previous coagulation results a month before were normal, although the PT was prolonged by one second. Further tests, including mixing studies, thrombin time and a protamine time, were performed, and the results were phoned urgently to the cardiac theatre team.

Bleeding
The laboratory then received a phone call from the Consultant Haematologist. The patient was not on any anticoagulants, and was on the theatre table undergoing cardiopulmonary bypass when the abnormal results were phoned. Vitamin K dependent factors (II, VII, IX and X) were requested and performed urgently, and the

consultant had advised theatre staff to give a bolus injection of vitamin K and transfuse fresh frozen plasma (FFP) as required. Surgery went ahead, but when the patient was returned to intensive care they were bleeding into their drain – 375mL in the first 30 minutes, and then a further 175mL in the next 30 minutes. Further FFP, plus red cells and platelets, were transfused, and protamine and tranexamic acid administered in an attempt to stem the bleeding. After the patient had drained 1250mL in three hours, a decision was made to return to theatre to look for a source of bleeding. No source was found, the patient returned to ICU where their condition deteriorated and they passed away a few hours later. In total, the patient received 20 units of packed red cells, 11 bags of FFP and 2 bags of platelets.

Looking back
The results of the factor assays confirmed that the patient was suffering from vitamin K deficiency. All of the vitamin K dependent factors were below 10%. The Factor VIII was normal, proving that the issue was vitamin K-related. In hindsight,

a Factor V should also have been performed to prove that the patient was not suffering from liver failure, although there was no indication of this in the patient’s notes and his liver function tests were normal pre-operatively. Looking back in the notes there were clues that the patient was suffering from a bleeding disorder. It was noted eight days pre-op that the patient had a large haematoma, where blood samples had been taken the previous day. The day before surgery bloods could not be taken due to “bruising from previous cannulation causing hardening and causing him pain”. The patient also had a tracheostomy in place following laryngeal cancer 16 years previously and the site of this was bleeding. However, no coagulation tests were sent to the laboratory until a pre-operative thromboelastography was performed in the cardiac theatres and revealed some abnormalities, such as a prolonged R (reaction) time.

Causes of deficiency
There are a variety of causes of vitamin K deficiency, although it is more common in babies and is relatively rare in adults.

TABLE 1. TEST RESULTS

	Result	Normal Range
Prothrombin Time	111 seconds	10-13
Activated Partial Thromboplastin Time	109 seconds	27-39
PT-derived Fibrinogen	4.6 g/L	2.1-4.8
Thrombin Time	17 seconds	12-16
TT with Protamine added	13 seconds	10-16
PT 50:50 mix with normal plasma	15 seconds	
APTT 50:50 mix with normal plasma	Not performed	
Actin FS (Lupus insensitive aPTT)	127 seconds	22-33
Factor II	7%	50-150
Factor VII	4%	50-150
Factor VIII	233%	50-150
Factor IX	8%	50-150
Factor X	3%	50-150

All neonates should receive a vitamin K injection shortly after birth to prevent vitamin K deficiency bleeding, although parents have the right to refuse this. Newborn infants are at an increased risk for a number of reasons, including: breast milk being very low in vitamin K, not producing their own vitamin K in the first few days of life, and an immature liver not using the vitamin efficiently. In adults the most common causes are dietary deficiency, prolonged use of antibiotics, and fat malabsorption syndromes, such as coeliac disease or cystic fibrosis. This particular patient had been prescribed antibiotics over three weeks prior to his death for infective endocarditis, which eventually led to him requiring surgical intervention. He was also described as having a poor dietary intake. These factors almost certainly led to him becoming vitamin K deficient. Because of the short half-life of the relevant factors, deficiency in the right circumstances can develop relatively quickly. Vitamin K is fat-soluble, which is a critical part of the coagulation cascade. It is a co-factor for γ -carboxylation, which is required for the synthesis in the liver of factors II, VII, IX and X, as well as the anticoagulant proteins, protein C and S. As both the intrinsic and extrinsic pathways of coagulation are affected, both the PT and APTT are affected, although the PT more so.

Lessons learned
This case study is a lesson for all involved on the importance of extensive note and history taking of patients and monitoring during a hospital stay, particularly if there is prolonged antibiotic use. Although rare, the development of vitamin K deficiency during an inpatient stay can have profound consequences, as this case study demonstrates.

