CLINICAL SCENARIO
An elderly woman attends your emergency department (ED) following a mechanical fall. She takes warfarin for atrial fibrillation and has a small occipital haematoma. Her Glasgow Coma Score (GCS) is 15; she has no amnesia and a normal neurological examination but did briefly lose consciousness. The International Normalised Ratio (INR) comes back within the therapeutic range at 2.9 and a CT scan is requested according to the National Institute of Health and Care Excellence (NICE) guidelines.

The scan is reported as normal, and her social circumstances are adequate in that she lives with her husband who can keep an eye on her. You wonder, though, whether it is safe to discharge her or if there is a possibility of delayed intracranial haemorrhage (DICH) due to her coagulopathy, and therefore she should be admitted for a period of neurological observation so that it can be identified and acted upon at the earliest opportunity.

THREE-PART QUESTION
In (adult patients on warfarin with a minor head injury) does a (normal CT brain scan) allow (safe discharge home)?

SEARCH STRATEGY
MEDLINE 1946 to August Week 4 2013 using the OVID interface. [(exp Craniocerebral trauma/ OR head injur$.mp) AND (exp Warfarin/ OR warfarin.mp OR exp Coumarins/ OR exp Anticoagulants/ OR anticoagula$.mp OR phenprocoumon.mp OR acenocoumarol.mp OR dicumarol.mp OR 4-hydroxycoumarins.mp OR sintrom.mp OR synthrome.mp OR coumadins.mp)] LIMIT to humans AND English language.

SEARCH OUTCOME
In total, 796 papers were found, of which 789 were irrelevant or of insufficient quality. The remaining seven were directly relevant to the three-part question and are summarised in the table 3.

COMMENTS
There is much debate in the literature as to how best to manage this group of patients. Their risk of immediate traumatic intracranial haemorrhage is increased to about one in six compared with those not warfarinised. The NICE guidelines tell us only to perform a CT scan in the presence of loss of consciousness or amnesia, but tell us nothing about the impact of coagulopathy or about a period of observation, especially if no CT is to be performed. From my research, it is clear that these patients are
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<td>Garra et al, 1999, USA</td>
<td>65 anticoagulated patients suffering minor head injury without LOC or acute neurological abnormality identified from retrospective chart review of electronic records from 6 community hospital EDs, including 1 trauma centre over 2-year period. 38 patients had PT assessment (range 12–30.7 s)</td>
<td>Cohort study</td>
<td>Clinically significant intracranial injury</td>
<td>No intracranial injury found in any of the 39 patients who had a CT. Telephone follow-up of the remaining 26 patients revealed no evidence of complications related to their head injuries</td>
<td>Their computer system may not have identified all eligible patients. In the 38 patients in whom PT was checked, none was &gt;30 s and almost 1/3 were &lt;14 s, indicating that even though these patients were on warfarin, few were actually anticoagulated.</td>
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<td>Cohen et al, 2006, USA</td>
<td>77 patients from 2 trauma databases over 3-year period on warfarin with minor head injury (GCS 13–15). Average age 68. INR obtained in 57% with average value 4.4 and values &gt;3 in 47%, range 1.8–9.5</td>
<td>Cohort study</td>
<td>Mortality</td>
<td>20 evaluated and sent home from ED. Of these, 35% had CT, all of which were normal. 18 returned to ED and subsequently diagnosed with a significant traumatic intracranial abnormality, 2 patients died at home, 1 with autopsy-confirmed acute SDH. Overall mortality in these 20 patients was 88.8%. 45 patients admitted for observation for head injury/treatment of other injuries. CT obtained before admission in 70%, with only 4 showing any traumatic intracranial abnormality—3 contusions and 1 traumatic SAH. Within 8–18 h of injury (mean 12 h), 80% deteriorated to GCS &lt;10 with the following CT abnormalities: acute SDH 31%; contusion 20%; intracerebral haemorrhage 20%; mixed lesions 29%. Mortality in this group 84%. 12 patients presented within hours or days of injury with neurological findings of an intracranial mass and CT evidence of a significant traumatic intracranial abnormality. All underwent emergent craniotomy with a resultant mortality of 83.3%</td>
<td>No matched control group. Majority of patients supra-therapeutically anticoagulated and, of those undergoing CT on initial presentation, only slightly &gt;30% had any evidence of traumatic intracranial abnormality. Conversely, because the majority of patients in this study did not have a CT until clinical deterioration, they may have harboured an intracranial haematoma that ‘enlarged’ secondary to underlying anticoagulation. Unclear who had reversal of anticoagulation. Again, no estimate of risk possible</td>
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<td>Itshayek et al, 2006, Israel</td>
<td>All anticoagulated head injuries are scanned in their level 1 trauma centre and during 21/2-year period they describe 4 patients (aged 65–86) presenting following minor head injury. All chronically anticoagulated (3 on warfarin 1 on Enoxaparin and aspirin). INRs of 3 warfarinised patients were 2.99, 3.03 and 3.2. All GCS 15, no LOC, no focal neurological deficit, no evidence of cranial fracture and normal CT on arrival in department</td>
<td>Case report</td>
<td>Development of DASH, morbidity and mortality</td>
<td>3 warfarin patients developed DASH with rapid neurological deterioration within 24 h, the patient on Enoxaparin and Aspirin deteriorated after 3/7. 3 out of 4 patients underwent craniotomy for evacuation of their haematomas. The 2 male patients died after complicated post-operative courses. 1 female patient underwent surgical evacuation and rehabilitation, eventually achieving a GOS of 3. In the 2nd female patient, the haematoma was treated conservatively and she achieved a GOS of 4</td>
<td>Only a small case series, but quantification of risk impossible. We are told that they treat a population of 800 000 but we are not told how many such patients with normal examinations and normal CT scans they saw out of which 4 developed DASH</td>
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<td>Kaen et al, 2010, Spain</td>
<td>137 consecutive adult anticoagulated patients with minor head injuries (GCS 14–15) sustained in previous 48 h over 15/12 period with normal initial CT scans. All admitted for 24 h observation with a control CT scan performed before discharge. All warfarinised but 3 also on aspirin</td>
<td>Prospective cohort study</td>
<td>Intracranial bleeding on 2nd CT scan</td>
<td>135 (98.6%) had no evidence of intracranial lesions on control CT and none developed subsequent neurological deterioration or needed neurosurgical intervention during observation period. Only 2 patients (1.4%) (INR 3.1 and 2.88) developed haemorrhagic lesions on control CT. Both patients on both warfarin and aspirin; difference in incidence of bleeding in these 2 cases compared with those only anticoagulated was statistically significant (p=0.01). Likewise, they were among 14 (10%) who had LOC, difference in frequency of bleeding compared with 90% without LOC also statistically significant (p=0.004)</td>
<td>Observational, non-randomised without a control group. Needs larger number of patients to establish definite conclusions</td>
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Table 3

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<td>Peck et al, 2011, USA</td>
<td>Retrospective review of protocol in level 1 trauma centre between 01/01/06 and 31/08/09, whereby those with blunt head trauma and preinjury use of an anticoagulant or antiplatelet agent (ACAP) (defined as warfarin, clopidogrel, heparin, or dipyrindamole and aspirin in combination) received an admission CT head (CT1) regardless of symptomatology, and for those without ICH on CT1, a period of observation followed by a routine 2nd CT (CT2) in 6 h. Excluded those solely on warfarin if INR &lt;1.3. Blinded review of CTs by radiologist. Attempts at follow-up across San Diego area. 600 patients qualified for protocol, of which 424 (85%) had –ve CT1. Mean age 75 with almost equal sex distribution, and 84% were a fall from standing. Mean GCS was 14.8. Mean initial INR for 312 warfarinised patients was 2.5 with 22 &gt;4: so largely a therapeutic cohort</td>
<td>Cohort study</td>
<td>Neurological deterioration during observation</td>
<td>CT1 –ve → CT2 +ve</td>
<td>15 patients (3.5%) had clear documentation of neurological deterioration; 397 (93.6%) showed no change; 12 (2.8%) had insufficient data. None of the 15 had a +ve CT2. 4 patients (1%), all warfarinised with INRs of 2.2, 2.2, 3.9 and 1.7. CT3 was stable or –ve in these cases; 3 were discharged and 1 died of cardiac disease following an orthopaedic procedure, all without intervention</td>
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<td>Menditto et al, 2012, Italy</td>
<td>97 prospectively enrolled consecutive warfarinised (for at least 152) patients ≥14 years old in level 2 trauma centre without ICH on 1st CT after minor head injury (any head trauma, other than superficial injury to face, presenting with GCS 14 or 15), regardless of presence of absence of LOC, within 48 h of injury, with ISS &lt;15 between Jan 2007–Mar 2010. Structured clinical pathway implemented, comprising 24-h period of observation and 2nd CT prior to discharge</td>
<td>Case series</td>
<td>Immediate TICH</td>
<td>Death</td>
<td>19/97 (16%) +ve initial scan</td>
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<td>Nishijima et al, 2012, USA</td>
<td>Prospective observational study at 2 trauma centres and 4 community hospitals’ EDs in California of patients ≥18 with blunt head trauma (most commonly ground level fall (83.3%), regardless of LOC/amnesia and preinjury warfarin or clopidogrel use (but not both) within previous 7/7 between Aug 2009–Jan 2011. Followed for 2/52 by review of in-patient electronic medical record or by telephone survey if already discharged. 1064 patients enrolled (768 warfarin (72.2%) and 296 clopidogrel (27.8%)). 364 (34.2%) from level 1 or 2 trauma centres and 700 (65.8%) community hospitals. 1000 received head CT in ED. Both warfarin and clopidogrel groups had similar demographics and clinical characteristics, although concomitant aspirin use more prevalent among clopidogrel group. Enrolled after screening by treating physician (14.7% missed by screening failure, but these had similar characteristics and outcomes). Repeat CT was at clinicians’ discretion. Excluded patients with known injury transferred in as their injuries would falsely inflate prevalence of TICH. 78.5% had INR checked, median 2.5, IQR 2.0–3.3</td>
<td>Cohort study</td>
<td>Immediate TICH</td>
<td>Neurosurgery</td>
<td>Admission</td>
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<td>aOR, adjusted OR; DICH, delayed intracranial haemorrhage; ED, emergency department; GCS, Glasgow Coma Score; INR, International Normalised Ratio; ISS, injury severity score; LOC, loss of consciousness; PT, prothrombin time; RR, relative risk; SDH, subdural haematoma; TICH, traumatic intracranial haemorrhage.</td>
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<td>et al, 2012, USA</td>
<td></td>
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<td>death</td>
<td>8/37 (21.6%) (95% CI 9.8% to 38.2%)</td>
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<td>et al, 2012, USA</td>
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<td>Neurosurgical intervention</td>
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<td>et al, 2012, USA</td>
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managed quite differently even within the same centre, in the absence of robust guidelines. Italian guidelines published in 1999, derived largely from a published case series of two patients with coagulopathy, advise a CT scan in all patients with coagulopathy, admission for observation for 24 h and then a second CT prior to discharge. Kaen et al here suggest that this second CT may not be necessary, with only 2/137 (1.4%) found to have DICH, both neurosurgically irrelevant. Peck et al show that a routine repeat CT after 6 h is also unnecessary.

DICH in this setting, with a normal admission CT and an International Normalised Ratio (INR) not supra-therapeutic, would appear to be a fairly rare occurrence, quoted as <1% in large studies by Nishijima et al and Peck et al. Indeed, the relative risk of DICH with an INR >3 was found to be 14 (95% CI 4 to 49) by Menditto et al. However, more often than not in the literature it is described following a previous discovery of a cranial fracture or following a clinical deterioration in a previously asymptomatic patient that had therefore not been initially scanned.

An important question to ask is whether such findings of DICH really matter? By admitting more patients, and ordering more scans, is outcome improved? Or do we just reveal positive findings of little clinical significance? Furthermore, very few of the DICH found in these studies occurred within 24 h; instead often after several days. So do we admit these patients for our own false reassurance?

Our practice seems largely to be based on anecdotal evidence, fuelled probably by such case series as presented here, but the larger studies described should reassure us as to the very low risk of DICH, particularly with an initial INR <3 and a normal CT scan. Therefore, it would seem reasonable to discharge these patients, but with robust and clear instructions. Some have even shown the effectiveness of telephone follow-up the following day.

**Clinical bottom line**

- The risk of delayed intracranial haemorrhage has been quantified as reassuringly small, rather than anecdotally inflated. Therefore, it would seem reasonable to discharge those with an International Normalised Ratio <3 and a normal initial CT scan, ensuring good instructions and follow-up.


**Provenance and peer review** Commissioned; internally peer reviewed.

doi:10.1136/emermed-2014-203646.3
BET 3: Observation is unnecessary following a normal CT brain in warfarinised head injuries: an update

doi: 10.1136/ememerd-2014-203646.3

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