AUDIT REPORT

Prescribing of Treatment Dose Dalteparin Based on Patient Weight and Renal Function, and the Recording of these Parameters on the Drug Chart.

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2. Introduction

Low molecular weight heparins (LMWHs) provide prophylaxis for venous thromboembolism (VTE) and are also used in the treatment of VTE and acute coronary syndromes. LMWHs are given parenterally by subcutaneous injection.

LMWHs are the effective treatment of choice, offering advantages over unfractionated heparins (UFH). The benefits include an improved bioavailability over UFH, a greater activity against factor Xa than factor IIa which suggests the production of an equivalent anticoagulant effect to UFH but with a lower risk of bleeding. In addition they cause less inhibition of platelet function and have a longer half-life, allowing once daily dosing. There is also a reduced risk of heparin-induced thrombocytopenia (HIT). This is an uncommon but potentially fatal complication of heparin therapy, occurring 5 to 14 days after initial exposure. An immune response is triggered against the heparin/platelet complexes resulting in a drop of the platelet count below the normal range. Paradoxically this is associated with severe thrombosis and the enlargement of an existing clot or the formation of new clots. All forms of heparin have been implicated in HIT but the incidences are fewer with LMWHs.¹

3. Justification

The anticoagulation of patients within the hospital setting is frequently associated with medication errors. An American study over a 3 year period, reviewed anticoagulation-related errors at the Harvard Medical School and found 1.67 medication errors for every 1000 patients treated with anticoagulants. LMWHs accounted for 9.2% of these errors.²

30% of the deaths reported to NYPORTS (The New York Patient Occurrence and Tracking System) between 2003 and 2008 were due to over anticoagulation medication errors.³ There were 17 occurrences (9 of which were patients being treated for DVT or PE) of prescribing error with LMWHs and 14 deaths. Six deaths were reported among patients with renal impairment who experienced bleeding
complications. There were 2 adverse events reported due to inaccurate reporting of the patients’ weights. This included one case where the units were recorded as lbs. instead of kg.

The Rapid Response Report (NPSA/2010/RRR014) from the National Patient Safety Agency has highlighted the potential for treatment dose errors during the prescribing of low molecular weight heparins.

In the prophylaxis of venous thromboembolism (VTE), a standard dosing regimen is used for most LMWHs, however, prescribed doses of LMWHs for the treatment of thromboembolic events are dependent on patient weight and renal function. The treatment dose is also dependant on the clinical indication for the therapy, examples of indications are given below.5

- Deep-vein thrombosis
- Pulmonary embolism
- Venous thromboembolism in pregnancy (unlicensed indication)
- Venous thromboembolism in patients with solid tumours
- Acute coronary syndromes
  - ST elevation myocardial infarction (STEMI)
  - Non ST elevation myocardial infarction (NSTEMI)
  - Unstable angina

Failing to consider renal function when prescribing LMWHs has been a leading cause of serious medication incidents. The renal function is a significant factor because LMWHs are excreted via the kidney and harmful accumulation can occur in patients with advanced renal failure. This leads to a significant risk of bleeding in this patient group. A dose reduction is required if the estimated glomerular filtration rate (eGFR) is <30ml/min. An eGFR value can be used as a guide for the initiation of therapy and then a calculation using the Cockcroft-Gault formula used to obtain a more accurate value.
Failure to weigh patients in hospital is a medication safety risk. A cross-sectional study from the Departments of Clinical Pharmacology, Aged Care and Rehabilitation at the University of Sydney looked at the prescribing of renally excreted drugs (including LMWHs). The study found that over 3 months, only 24% of patients were weighed on admission and of those prescribed renally excreted drugs 26% were weighed. This led to an increase in haemorrhagic complications for those patients who were not weighed and had received treatment doses of anticoagulants. At Salisbury District Hospital, the process of weighing a patient on admission (and when necessary, during therapy) was explored through the following audits relating to nutritional status;


Recommendations arising from these audits include the need for access to accurate scales or hoists/under-bed scales.

Dosing errors occur if the treatment dose is not prescribed according to the patient’s current weight. This may occur for the following reasons.

- The patient is not weighed
- Doses based on the weight are miscalculated
- The weight value is recorded inaccurately
- The body weight is inaccurately estimated (by healthcare staff or the patient themselves)

A 2004 study in Canada found a wide discrepancy between the value given for the weight as stated by the patient compared with that of the patient’s actual weight.

The patient’s weight should be recorded accurately in kilograms on the inpatient drug chart. Patients should be weighed at the start of therapy, though this should not delay the initial dose, and if applicable, during treatment.

Underdosing with LMWHs can increase the risk of further thromboembolic events and overdosing can increase the risk of bleeding.
The LMWHs considered within the Rapid Response Report include dalteparin (Fragmin™), enoxaparin (Clexane™), tinzaparin (Innohep™) and bemiparin (Zibor™). For the purpose of this audit, the prescribing of dalteparin is studied, as the preferred LMWH used at Salisbury District Hospital.

4. Aims and Objectives

This audit aims to establish if the prescribing of treatment doses of dalteparin is based on patient weight and renal function according to NPSA Guidelines. The audit will also determine whether or not the patient weight and renal function is recorded on the drug chart according to Trust Guidelines.
5. Standards

<table>
<thead>
<tr>
<th></th>
<th>Audit standard</th>
<th>Percentage</th>
<th>Exceptions</th>
<th>Evidence</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The patient’s weight should be recorded on their drug chart.</td>
<td>100</td>
<td>None</td>
<td>The patient’s weight is used as the basis for calculating the required treatment dose of dalteparin</td>
<td>The patient is weighed on admission and the value recorded.</td>
</tr>
<tr>
<td>2</td>
<td>An estimation of the renal function for each patient should be calculated and taken in to account with reference to prescribing.*</td>
<td>100</td>
<td>None</td>
<td>Dalteparin is excreted renally so the prescribing of this drug must take in to consideration the patient’s renal function.</td>
<td>An estimation of renal function can be determined by calculating eGFR or using the Cockcroft and Gault equation to determine creatinine clearance.</td>
</tr>
<tr>
<td>3</td>
<td>The estimation of the renal function for each patient should be recorded on their drug chart.</td>
<td>100</td>
<td>None</td>
<td>Dalteparin is excreted renally so the prescribing of this drug must take in to consideration the patient’s renal function.</td>
<td>The renal function can be recorded as the eGFR or creatinine clearance calculated from the Cockcroft and Gault equation.</td>
</tr>
</tbody>
</table>

Table 1 – Audit standards

*  an eGFR value is generated for all patients as part of routine blood screening and is available online from Results Reporting (or Review).
6. Method

Data collection was achieved using the form given in Appendix 1. The following pieces of information were gathered for each patient receiving a treatment dose of dalteparin.

- Hospital number (to allow retrospective analysis if required)
- Was the patient weighed on admission?
- Has a weight been estimated on the ward?
- Has a previous weight been used?
- Did the patient give the weight?
- What is the given weight?
- Has the patient’s weight been recorded on the drug chart and if not, has it been recorded elsewhere?
- Has the value of eGFR or CrCl been recorded on the drug chart?
- Has the CrCl been calculated using Cockcroft and Gault?
- Was the correct dalteparin dose prescribed?
- If an incorrect dose was prescribed, what was it?
- Was an incorrect dalteparin dose given to the patient, and if so, how many?

The data was collected by the ward pharmacists during their normal working activities.

A pilot of the data collection form was undertaken in order to establish ease of use and relevance of the questions chosen. The pilot was carried out over one day on Tisbury and Amesbury wards and as a result the form was modified. The modifications included expanding the options to establish which weight was recorded i.e actual weight on admission, estimate by ward staff, estimate by patient or previous weight. It was difficult to allow for every combination of events using a single form and the details collected for some patients were incomplete.
7. Results

Over a 2 week period, the details of 34 patients receiving a treatment dose of dalteparin were collected from the following wards.

<table>
<thead>
<tr>
<th>Ward</th>
<th>Number of patients included in the audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amesbury (orthopaedic)</td>
<td>1</td>
</tr>
<tr>
<td>Downton (surgical/ENT)</td>
<td>3</td>
</tr>
<tr>
<td>Pembroke (Medicine – haematology, oncology, respiratory)</td>
<td>2</td>
</tr>
<tr>
<td>Pitton (Medicine – gastro/endocrine)</td>
<td>2</td>
</tr>
<tr>
<td>Radnor (Intensive care)</td>
<td>2</td>
</tr>
<tr>
<td>Tisbury (Medicine – cardiology)</td>
<td>16</td>
</tr>
<tr>
<td>Whiteparish (Medical admissions)</td>
<td>7</td>
</tr>
<tr>
<td>Winterslow (Elderly)</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2 – Patient numbers for each ward included in the audit
The following data were obtained in relation to the achievement of the given standards and are also shown graphically in Figure 1.

<table>
<thead>
<tr>
<th>STD</th>
<th>Audit standard</th>
<th>% required to achieve standard</th>
<th>Actual % achieving standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The patient’s weight should be recorded on their drug chart.</td>
<td>100</td>
<td>70.6</td>
</tr>
<tr>
<td>2</td>
<td>An estimation of the renal function for each patient should be calculated and taken in to account with reference to prescribing.*</td>
<td>100</td>
<td>35.3</td>
</tr>
<tr>
<td>3</td>
<td>The estimation of the renal function for each patient should be recorded on their drug chart.</td>
<td>100</td>
<td>26.5</td>
</tr>
</tbody>
</table>

* an eGFR value is generated for all patients as part of routine blood screening and is available online from Results Reporting (or Review).
8. Discussion

The results of this audit failed to reach the required 100% for the three standards given above. The standards relating to the calculation (and use with reference to prescribing) and the recording of renal function achieved the lowest values.

Of the 34 patients, a weight was recorded for 30, either in the drug chart, handover sheet or elsewhere in the patient notes (88.2% of the sample). Of this figure, 58.8% were weighed on admission. For the remainder, the majority had their weight estimated by the ward staff (14.7%), the weight was given by the patient (8.8%) or a previous weight was used (5.9%).

For two patients on Tisbury ward, the weight had been estimated by the patient but this figure was found to be incorrect when the pharmacist requested the patient was weighed.

Figure 1 – Percentage achievement of the given standards
In cases where estimates of weights were given, figures were quoted as an approximation (for example, ~52kg) or a lower limit (for example, >83kg). In all cases, metric weights were quoted.

For 24 out of the 34 patients (70.6%), the weight value was recorded on the drug chart according to Trust Guidelines. In only one case was the weight recorded elsewhere in the patient notes.

In the cases where the eGFR was determined or the CrCl had been calculated, this process was undertaken and the results recorded by the ward pharmacist. This audit revealed that it is not uncommon for the value to be recorded on the pharmacist’s handover sheet and not the drug chart.

The incorrect treatment dose of dalteparin was prescribed for 11 patients (32.4%). For 2 of these patients the error was detected by the ward pharmacist before treatment was given. For the remaining 9 patients an incorrect dose was given. In 7 cases the pharmacist intervened and had the dose altered. In 1 case the patient refused all subsequent treatment (the reasons for this were unrelated to the dalteparin) and in 1 case the patient was discharged having received an incorrect dose on the ward. Treatment was not continued at home.

Of the 9 patients who were prescribed and received incorrect doses, the following details were documented:

- Patient 1 – received 1 incorrect dose and then the dose was corrected by the ward pharmacist
- Patient 2 – given a prophylaxis dose and not a treatment dose
- Patient 3 - received 2 incorrect doses and then the dose was corrected by the ward pharmacist
- Patient 4 - received 2 incorrect doses and then the dose was corrected by the ward pharmacist
- Patient 5 - received 1 incorrect dose and then refused all further treatment
- Patient 6 - received 1 incorrect dose and then the dose was corrected by the ward pharmacist
- Patient 7 – received an incorrect dose, number of doses – data not collected
- Patient 8 – received an incorrect dose, number of doses – data not collected
- Patient 9 – received an incorrect dose, number of doses – data not collected

The following table includes details of the incorrect doses given.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Correct dose</th>
<th>Dose given</th>
<th>Number of doses given</th>
<th>Under or over dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9500</td>
<td>7500</td>
<td>1</td>
<td>under</td>
</tr>
<tr>
<td>2</td>
<td>Data not collected</td>
<td>5000</td>
<td>Data not collected</td>
<td>Data not collected</td>
</tr>
<tr>
<td>3</td>
<td>9000</td>
<td>9500</td>
<td>2</td>
<td>over</td>
</tr>
<tr>
<td>4</td>
<td>9500</td>
<td>7500</td>
<td>2</td>
<td>under</td>
</tr>
<tr>
<td>5</td>
<td>6500</td>
<td>12500</td>
<td>1</td>
<td>over</td>
</tr>
<tr>
<td>6</td>
<td>9000</td>
<td>8500</td>
<td>1</td>
<td>under</td>
</tr>
<tr>
<td>7</td>
<td>Unknown, no weight recorded</td>
<td>7500</td>
<td>&gt;2</td>
<td>unknown</td>
</tr>
<tr>
<td>8</td>
<td>10000</td>
<td>9000</td>
<td>Data not collected</td>
<td>Data not collected</td>
</tr>
<tr>
<td>9</td>
<td>10000</td>
<td>9500</td>
<td>Data not collected</td>
<td>Data not collected</td>
</tr>
</tbody>
</table>

Table 4 – Details of incorrect doses received by patients
9. Conclusions

Though it is difficult to pin-point the exact causes of dosing errors, this audit has highlighted potential sources of dosing errors with LMWHs which can be summarised below:

- Weighing equipment may be unavailable, broken or unreliable (this may be standard scales or for hoists/under-bed scales for bedbound or obese patients).
- There may be unfamiliarity with weight-based guidelines by the ward staff.
- The design of the medication chart may result in inadequate recording of renal function, patient weight and LMWH dosing.
- There may be a poor understanding of the different dosing and frequency based on indication of therapy.
- Calculation skills and tools may be inadequate.
- The ward and pharmacy staff may fail to ensure a safe dose is provided before administration. The pharmacist may be unable to intervene in the case of a dosing error occurring over a weekend (this accounts for the 2 incorrect doses given before the situation is rectified see Table 4.)

10. Action Points

The doses of LMWHs prescribed for the treatment of acute coronary syndromes and DVT/PE are dependent on patient weight and renal function. If the patient is given too low a dose there is an increased risk of a further thromboembolic event, while overdosing can increase the risk of bleeding.

Because of these prescribing parameters, all NHS organisations should ensure the following:

i) Determination and recording of patient weight

The patient’s current weight is used to calculate the required treatment dose of LMWH. The guidelines must have a clear reference to weight in kilograms (kg)
which must be accurately recorded in the inpatient drug chart. There should be a designated space for recording weight, allowing staff to record, find and use the weight efficiently. Patients should be weighed at the start of therapy and, where applicable, during treatment. In some Trusts a section of the drug chart is designated for the prescribing of anticoagulation treatment, giving dose banding according to weight and boxes to complete with patient weight, dose, time etc however this can result in an excessively complicated drug chart. At Salisbury District Hospital, up to date dosing tables are kept on each ward which allows a simpler, straightforward drug chart design. In order for a patient to be weighed, NHS organisations should ensure that ward based healthcare staff have access to accurate scales (Class III Type) and that the scales are maintained and calibrated regularly. All patients should be weighed on arrival at the ward as part of the admission process. This would allow drug dose modifications for any medication required during the patient’s treatment where the dose is determined by weight and not just for dalteparin administration. Weight estimation tools such as formulae using knee, height and mid arm circumference could be considered for patients where physical weighing is not possible. These methods have been shown to provide body weight information that is more accurate than estimates by healthcare staff.11,12,13 Anthropometric measurements could be made on the ward and weight estimations obtained using on-line anthropometry calculators. This method has shown to give values within 10% of actual values for around 70% of patients. Values tend to be more accurate for males than females.

ii) Calculation tools regarding renal function

Renal function must be considered when prescribing treatment doses of LMWHs. Information and further advice on dose recommendations should be accessible to prescribers treating patients with limited renal function. The renal function test should not delay initiation of the first dose but should be used to adjust subsequent doses if necessary. The eGFR or CrCl should be clearly recorded on the drug chart and not solely as part of the pharmacist’s handover sheet. At Salisbury District Hospital, guidance regarding dosing in renal impairment is available electronically via ICID at;
Dose calculation tools should be available for a range of body weights, different clinical indications and renal function for the LMWHs used by the NHS organisation. At Salisbury District Hospital, an eGFR calculator is available electronically via ICID at www.icid.salisbury.nhs.uk.

There is currently no designated space for the recording of renal function on the drug chart used at Salisbury District Hospital. The drug chart is currently under review and a mandatory section (similar to that used for allergy status) would improve the recording of renal function.

iii) Transfer of care

Information such as weight, renal function, indication and treatment duration should be clearly communicated at transfers of care from the hospital setting to primary care. To facilitate this, it is important to ensure these figures are recorded clearly on the drug chart so that the information is included within the electronic discharge summary. If these values are recorded only on the pharmacist's handover sheet then this information could be lost during the transfer process.

iv) Responsibilities of ward staff

Checks are made regarding LMWHs doses by the ward staff responsible for the patients receiving the treatment. The information gathered during this audit demonstrated the role of the pharmacist in highlighting incorrect dosing though the pharmacist would be unable to do this outside of normal working hours.

v) Continuing improvements to care

Improvements should be demonstrated via the collection of incident reports, pharmacy interventions or audit. At Salisbury District Hospital, interventions are recorded by the ward pharmacists concerned and audits regarding the weighing
of patients on admission are currently undertaken as part of the determination of
the nutritional status of patients on admission.
11. References

