Venous Thromboembolism in Major Trauma Patients

- Major trauma patients are one of the high risk groups for venous thromboembolism (VTE).
- Without thromboprophylaxis, about ½ the major trauma patients seen at Sunnybrook had asymptomatic DVT.
- Without thromboprophylaxis, fatal pulmonary embolism is one of the most common causes of death following trauma.

### RISKS OF DVT IN HOSPITALIZED PATIENTS*

<table>
<thead>
<tr>
<th>Patient Group</th>
<th>DVT Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal cord injury</td>
<td>60-100%</td>
</tr>
<tr>
<td>Major trauma</td>
<td>40-80%</td>
</tr>
<tr>
<td>Knee/hip arthroplasty</td>
<td>40-60%</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>40-60%</td>
</tr>
<tr>
<td>Tibial fracture</td>
<td>20-40%</td>
</tr>
<tr>
<td>General abdominal surgery</td>
<td>15-40%</td>
</tr>
</tbody>
</table>

* based on studies using routine objective screening for asymptomatic DVT in patients not receiving thromboprophylaxis

- Among trauma patients, some of the **risk factors** that increase the risk of VTE include:
  - Spinal cord injury
  - Lower extremity or pelvic fracture
  - Major head injury
  - Immobility
  - A surgical procedure
  - Blood transfusion
  - Age

### History of Thromboprophylaxis in Trauma Patients at Sunnybrook

The approach to thromboprophylaxis in trauma patients at Sunnybrook has evolved through 3 phases over the past 20 years:

1. Prior to 1989 - no thromboprophylaxis of any kind was given to trauma patients because of the absence of evidence and concerns about bleeding with anticoagulant thromboprophylaxis;
2. 1989-94 - enrollment of trauma patients into two large prospective studies at Sunnybrook. The 1st used no prophylaxis but had routine contrast venography day 7-21 – patients with venographic DVT were treated but those without DVT were not [1]. The 2nd was a double-blind RCT (1992-
94) and compared low dose heparin with the low molecular weight heparin (LMWH), enoxaparin 30 mg SC BID [2];

The changes in our approach have resulted from:
1. our own clinical trials at Sunnybrook in trauma patients;
2. accumulation of other published data about the risks of thrombosis in trauma;
3. studies of the efficacy and safety of different methods of prophylaxis in nontrauma patients; and
4. the extensive experience of the Thromboembolism Service at Sunnybrook, which has assessed and followed every trauma admission since 1992.

Principles of Thromboprophylaxis in Trauma at Sunnybrook
The available data provide compelling support for the use of prophylaxis in all major trauma patients and routine prophylaxis is the standard of care in our institution. Furthermore, we have witnessed a substantial reduction in the development of symptomatic VTE (and fatal pulmonary emboli) among trauma patients both while they are in the hospital and after discharge with the routine use of thromboprophylaxis. Therefore, at Sunnybrook, since 1992, we have had a formal and mandatory prophylaxis policy for every major trauma patient – our objective is to use the most effective, safest, most convenient, and most cost-effective prophylaxis we can.

The trauma thromboprophylaxis program is based on the following principles:

A. Universal
   - Every trauma surgeon agrees to have their patients included in the prophylaxis program (this program cannot be used by some surgeons and not by others caring for the same group of patients).
   - All of the patients in each of the risk groups are included unless there is a clinical reason to exclude them.

B. Consistent
   - Where possible, we try to have a consistent approach to prophylaxis for each patient in a given group and even for all high risk groups rather than a different approach for each patient or group. However, because of the heterogeneity of major trauma patients, individual patient assessment is required and there is some variability in the prophylaxis used in these patients.

C. Safe
   - The first priority is to not cause clinically important bleeding.
   - The prophylaxis begins as soon as it is safe to do so for that particular patient (i.e. once there is evidence that primary hemostasis has been achieved). This implies that an experienced physician, pharmacist or
nurse must actively decide when it is safe to commence prophylaxis rather than basing this decision on a fixed algorithm alone. Evidence for primary hemostasis is based on a combination of all of the following:

a) hemovac or other drainage, if applicable,
b) the patient’s Hb trends,
c) the need for blood transfusion,
d) the appearance of the patient’s surgical or injury site(s), and
e) the results of imaging, if relevant.

D. Long Enough
- The duration of prophylaxis is partly based on evidence (or the lack of evidence) from clinical trials and partly based on our own, extensive experience. Prophylaxis usually continues for the duration of hospital stay, including rehab (not just “while the patient is immobile”).
- For patients who do go to rehab, the prophylaxis is generally continued during the rehab stay.
- We do not stop in-patient prophylaxis “when the patient is ambulatory”.
- For major trauma patients, post-discharge prophylaxis is not used for the following reasons:
  a) there is no data from clinical trials or cohort studies of trauma patients in which the risk of post-discharge VTE has been assessed;
  b) our own 20 year experience of almost 20,000 major trauma patients strongly suggests that the risk of post-discharge, symptomatic VTE is very low (~ 1-3 patients per year);
  c) the enormous costs, logistical effort and potential risks of widespread post-discharge prophylaxis.

LOW MOLECULAR WEIGHT HEPARIN (e.g. enoxaparin)

Advantages:
1. Highly efficacious method of prophylaxis and the best studied thromboprophylaxis modality in trauma
2. Good quality studies in most of the other high-risk groups (general surgery, orthopedic surgery)
3. Use of prefilled syringes
4. (Almost) the same dose for everyone - at the same time, can use different doses if necessary
5. Can be used if patient is NPO
6. No lab monitoring
7. High acceptance by patients and nurses.
8. Vast Sunnybrook experience using LMWH in trauma
9. HIT is very rare

Disadvantages:
1. Potential for bleeding (generally overcome with use of delayed initiation of prophylaxis) – also, has not been an issue at Sunnybrook
TRAUMA PROPHYLAXIS GUIDELINES:
1. Every Sunnybrook major trauma patient is assessed for thromboembolic risk and for thromboprophylaxis.
2. The only trauma patients who do not receive thromboprophylaxis are those with the combination of minor injuries, fully mobile, and likely to have a hospital stay of less than a few days. Even for patients initially considered to be at low risk for VTE, we usually start prophylaxis because we have seen major PE in such patients and because some patients, initially considered to be at low risk, have additional injuries identified or have a more complicated course than predicted. This is also consistent with our knowledge that it is very difficult to identify a trauma subgroup with sufficiently low VTE risk to preclude the need for prophylaxis.
3. The first question we ask is: “Does this trauma patient have frank intracranial bleeding or ongoing bleeding elsewhere?” If so, they get bilateral, calf-length T.E.D. stockings initially. This initially applies to approximately 20% of our major trauma patients. For patients with active bleeding, delayed prophylaxis with enoxaparin is started once there is evidence that primary hemostasis has been achieved. For patients with intracranial bleeding, the T.E.D.s are continued until approximately day 5-7 after which enoxaparin is generally commenced.
4. For the approximately 80% of trauma patients who do NOT have frank intracranial bleeding or active bleeding elsewhere, we start enoxaparin as soon as it is safe to do so (usually within 24-36 hours after injury). We generally do not start enoxaparin the day of injury but, rather, usually wait at least 12 hours after injury to assess the patient’s hemostatic stability.
5. The usual initial prophylaxis in trauma patients is one of two options:
   a) For most patients: enoxaparin 40 mg SC once daily given at 2200 hrs (this dosing time is selected for consistency reasons and because it will not interfere with any procedures the next day i.e. the evening dose is not held for next-day surgery, line insertion or removal, tracheostomy, PEG insertion, etc).
   b) For patients at higher risk (multiple or major lower extremity fractures, spinal cord injury) enoxaparin 30 mg SC BID.
6. In particularly high-risk patients, after about 5 days, we usually increase the enoxaparin dose to 30-40 mg SC Q12H. These patients include:
   - Spinal cord injury
   - Major lower extremity orthopedic injury
   - Weight > 100 kg
   This is done in the absence of prospective studies and is based on the known high rates of asymptomatic DVT in these groups of patients who have received the “usual” doses of LMWH. Bleeding has not been an issue with this delayed increased dose of LMWH.
7. Spinal cord injury patients are the highest risk group for DVT and fatal PE among trauma patients. Our prophylaxis for SCI patients with complete neurologic deficits is LMWH (enoxaparin 30 mg SC BID) starting as soon as there is evidence of primary hemostasis (usually 24-36 hours after
injury). If they are hemostatically stable, we increase the dose to enoxaparin 40 mg SC Q12H after 3-7 days because of the extremely high TE risk. For patients with incomplete SCI, we adopt a more conservative approach to reduce the potential for increasing perispinal bleeding (and thereby worsening the neurologic deficit): we review the results of the spinal imaging (CT or MRI) prior to starting anticoagulant prophylaxis; if no “significant” perispinal hematoma is present, we commence enoxaparin 30 mg SC BID and continue for approximately 2-3 weeks before considering warfarin.

8. After ~1 week (sometimes longer e.g. the patient is still unstable in the Critical Care Unit), if the patient is stable, has completed surgical procedures, still needs to be in hospital, AND remains at high risk for VTE, we sometimes convert to full-dose warfarin (INR 2-3) for the duration of hospital stay, including rehab. This approach is generally confined to spinal cord injury patients and major lower extremity orthopedic injuries.

9. We do not hold any doses of enoxaparin for delayed surgical procedures (incision & drainage, IM nailing, bone or skin grafting, laparotomy, tracheostomy, percutaneous endoscopic gastrostomy insertion). Postoperatively, enoxaparin is generally restarted the same evening unless there are concerns about excessive postop bleeding.

10. For patients with intracranial bleeding plus lower extremity fracture, we use no prophylaxis early (since they cannot have either enoxaparin or bilateral T.E.D.s). For these patients, we obtain a screening bilateral PROXIMAL venous ultrasound between day 5 and 7 and, if negative, we generally start enoxaparin at prophylactic doses. If the screening DUS demonstrates a proximal DVT, the patient is generally given therapeutic anticoagulation (usually enoxaparin 1 mg/kg SC BID or 1.5 mg/kg once daily). (See Enoxaparin Treatment Dose Banding According to Weight and Renal Function document)

11. When Orthopedic Trauma patients are transferred to Sunnybrook from other hospitals several days after injury, unless we are certain they have received “aggressive” prophylaxis prior to transfer, they generally have bilateral lower extremity venous Doppler ultrasonography as soon as possible after transfer on the assumption that they may already have DVT. This is most often done in delayed transfer patients if they are transferred for a surgical procedure (such as pelvic fracture repair).

12. For most trauma patients who are being discharged from the hospital, we discontinue the prophylaxis at discharge (this includes patients who are not mobile and those with lower extremity fractures, casts, etc). For spinal cord or orthopedic trauma patients going to a rehab center, we recommend continuation of the prophylaxis (usually warfarin) in the rehab center.

Other Thromboprophylaxis Issues:
- We NEVER use unilateral mechanical prophylaxis i.e. T.E.D.s (on the uninjured leg only) and would NEVER consider application of upper extremity mechanical devices in patients with bilateral leg injuries.
- We NEVER use prophylactic IVC filters for trauma (or any other) patients. The only indication for an IVCF in trauma is a proven proximal
DVT and an absolute contraindication to therapeutic anticoagulation. This is uncommon because of the effectiveness of thromboprophylaxis and since the overwhelming majority of trauma patients with symptomatic VTE will not have an absolute contraindication to anticoagulation at the time the VTE is diagnosed.

- We believe that the literature does not support routine screening of any patient group (including trauma patients) for asymptomatic DVT with DUS. The yield is low and the costs per DVT detected are enormous. Therefore, we do not routinely screen trauma patients. The only patients that we do screen are:
  1) delayed orthopedic trauma transfers, and
  2) trauma patients who are unable to have any prophylaxis within the first week of admission because of the combination of high bleeding risk and a major lower extremity injury.

### Summary of Usual Prophylaxis in Hospitalized Trauma Patients*

<table>
<thead>
<tr>
<th>Trauma Subgroup</th>
<th>Early Prophylaxis (1st 5-7 days)</th>
<th>2nd week</th>
<th>Later (≥ 2 weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial bleed</td>
<td>bilateral, properly measured T.E.D.s</td>
<td>enoxaparin 40 mg SC QHS</td>
<td>enoxaparin 40 mg SC QHS</td>
</tr>
<tr>
<td>Other head injury</td>
<td>enoxaparin 40 mg SC QHS</td>
<td>enoxaparin 40 mg SC QHS</td>
<td>enoxaparin 40 mg SC QHS</td>
</tr>
<tr>
<td>Other active bleeding or very risk for bleeding</td>
<td>T.E.D.s until bleeding risk decreases → enoxaparin</td>
<td>enoxaparin</td>
<td>depends on TE risk</td>
</tr>
<tr>
<td>Spinal cord injury</td>
<td>enoxaparin 30 mg SC BID</td>
<td>↑ enoxaparin dose bid +/- start warfarin</td>
<td>warfarin</td>
</tr>
<tr>
<td>Major lower extremity fractures</td>
<td>enoxaparin 30 mg SC BID</td>
<td>enoxaparin BID +/- start warfarin</td>
<td>warfarin</td>
</tr>
<tr>
<td>General surgery trauma</td>
<td>enoxaparin 40 mg SC QHS</td>
<td>enoxaparin 40 mg SC QHS</td>
<td>enoxaparin 40 mg SC QHS</td>
</tr>
<tr>
<td>Other trauma</td>
<td>enoxaparin 40 mg SC QHS</td>
<td>enoxaparin 40 mg SC QHS</td>
<td>enoxaparin 40 mg SC QHS</td>
</tr>
</tbody>
</table>

* because of the complexity and heterogeneity of trauma patients, there may be exceptions to the above usual prophylaxis.

### References: