ABSTRACT
This prospective, analytical study was conducted in our university hospital from June 2010 to September 2011 and aimed to know the effect of abdominal compression on the transverse diameter of femoral vein using ultrasonography on stable patients in emergency room and intensive care units. All the stable patients in emergency room [ER] and in Intensive Care Units [ICUs] were included in the study. Patients with acute abdomen, abdominal and pelvic trauma presenting to ER, patients with ascites, peripheral vascular disease, abdominal aortic aneurysm, congestive cardiac failure, pediatric patients less than 12 years were excluded from the study. The femoral vein was located using ultra sound machine with two-dimensional 10 MHz linear probe aligned transversely at 2 cm distal to groin. The transverse diameter of the femoral vein was measured at the same level and repeated after applying gentle abdominal compression below the umbilicus using the palm of both hands. This procedure is done on both sides. Measurements were recorded and statistically analyzed. This study was conducted on 195 cases. The mean and standard deviation of the transverse diameter of the right femoral vein before abdominal compression was 11.1 mm and +/-1.48mm and that after abdominal compression was 14.14mm and +/- 1.56mm. The mean and standard deviation of the transverse diameter of the left femoral vein before abdominal compression was 10.1mm and +/- 1.44mm and that after abdominal compression was 13.26mm and +/-1.46mm. This study concludes that abdominal compression increases the transverse diameter of femoral vein.

Keywords: Abdominal compression, Central venous cannulation, Femoral vein, Ultrasound.

INTRODUCTION
Central venous cannulation is one of the commonest procedures done in Emergency and Critical Care Medicine. Though cannulation of the Subclavian and the Internal Jugular Vein [IJV] is mostly preferred sometimes it is essential to cannulate femoral vein especially in case of coagulation abnormalities, burns in the upper part of torso and neck, poor accessibility during cardio pulmonary resuscitation(1, 2, 3, 4, 5, 6, 7, 8). Femoral vein access is utilized in adult and pediatric critical care as well as anesthesia, cardiac pacing, resuscitation, chemotherapy administration, and long term dialysis. More over the femoral vein cannulation is considered easy compared to other central vein cannulations (9). Even femoral vein cannulation is associated with complications such as bleeding, false passage and failure rates especially in obese patients and those with anatomical variations (8, 10, 11). The incidence however has drastically decreased following the introduction of Ultrasonography [USG] to assist cannulation (12).

It is believed that cannulation will be easier when the vein is dilated by occluding the vein proximal to cannulating site, and usually followed when peripheral vein is cannulated (6, 7). This concept is not routinely followed when femoral vein is cannulated (8, 10, 11). Hypothesis is that the abdominal compression could increase the femoral vein diameter.
MATERIALS AND METHODS

Study Design:-
A prospective and analytical study.

Study Setting and Population:-
This study is conducted in our Vinayaka Mission’s University Hospital. Our university hospital has 30 bedded emergency room and medical, surgical, cardiac and pediatric intensive care units managed by emergency physicians and anesthesiologists. Our emergency room is managed by emergency physicians and all the patients will be stabilized by emergency physicians before shifting to appropriate specialty.

Period:-
June 2010 to September 2011.

Methods:-
All the stable patients in Emergency Room[ER] and patients in Intensive Care Unit [ICUs] were included in the study. Patients with acute abdomen, abdominal and pelvic trauma, ascites, peripheral vascular disease, abdominal aortic aneurysm, congestive cardiac failure, pediatric patients less than 12 years were excluded from the study. All the patients who had been included in the study were explained about the procedure and consent was received prior to the procedure. An emergency physician or an anatomist who is well trained in ultrasonographic assessment of femoral vessels had done the procedure. A female staff nurse accompanied the patient when the assessment was done on female patients.

Patients were made to lie supine on the cot, and the lower limb was slightly abducted at hip joint and semi flexed at knee joint. A folded blanket was placed under the lateral aspect of lower thigh to make the patient comfort. Groin and upper part of thigh was exposed on the side of assessment.

The femoral vein was located using Chison ultra sound machine [FIGURE 1] with two-dimensional 10 MHz linear probe [FIGURE 2] aligned transversely at 2 cm distal to groin [FIGURE 3].

The femoral artery was identified as rounded, relatively thick walled, pulsatile structure, which fails to get compressed when compression was applied with the probe by the examiner. The femoral vein was then identified by looking medial to artery [FIGURE 4] which is relatively larger, nonpulsatile and collapsible [FIGURE 5] when compression was applied with the probe by the examiner.

The maximum transverse diameter of the femoral vein was measured in millimeters at the level 2 cm below the groin. The location is marked and gentle abdominal compression was applied below the umbilicus using the palm of both hands [FIGURE 6]. At the end of 2 minutes the transverse diameter of the femoral vein was reassessed at the same marked position.

The same procedure was repeated on the other side and transverse diameter of femoral vein was documented in millimeters before and after the abdominal compression. Patient comfort was maintained throughout the procedure.

RESULTS

A total of 250 cases were enrolled in the study of which 195 were included and 55 were excluded. Of the 195 cases, it was seen that the transverse diameter of the right femoral vein was larger than that of left femoral vein. The mean and standard deviation of the transverse diameter of the right femoral vein before abdominal compression was 11.1mm and +/-1.48mm and that after abdominal compression was 14.14mm and +/-1.56mm (Table 1 and Graph 1). The mean and standard deviation of the transverse diameter of the left femoral vein before abdominal compression was 10.1mm and +/-1.44 mm (Table 2 and Graph 2) and that after abdominal compression was 13.26mm and +/-1.46mm respectively. The increase in the transverse diameter is statistically significant and carries P value <0.001.
FIGURE 1: CHISON USG MACHINE

FIGURE 2: LINEAR PROBE

FIGURE 3: PROBE LOCATION 2 CM DISTAL TO GROIN

FIGURE 4 and 5: ULTRASONOGRAPHIC ASSESSMENT OF FEMORAL VEIN (FV) WHICH IS COLLAPSING ON PRESSURE AND LOCATED MEDIAL TO ARTERY (FA).

FIGURE 6: ULTRASONOGRAPHIC REASSESSMENT OF FEMORAL VEIN DIAMETER AFTER 2 MINUTES OF ABDOMINAL COMPRESSION

Table 1: Mean Femoral Vein Diameter (in mm) on right side before & after abdominal compression (n=195)

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Before Compression Mean (mm)</th>
<th>Before Compression SD (mm)</th>
<th>After Compression Mean (mm)</th>
<th>After Compression SD (mm)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>11.10</td>
<td>1.48</td>
<td>14.14</td>
<td>1.56</td>
<td>54.859</td>
<td>0.00014</td>
</tr>
</tbody>
</table>

(p < 0.001, significant)

Graph 1: Mean femoral vein diameter (in mm) on the right side before & after abdominal compression
This is a scatter diagram showing changes in the mean diameter of the femoral vein on the right side before and after application of abdominal compression. The mean femoral vein diameter on the right side before abdominal compression was found to be 11.1 with a SD +1.48 which following abdominal compression increased to 14.14 with a SD +1.56. Table 2 shows a p value < 0.001 by unpaired “t” test which is highly significant.

<table>
<thead>
<tr>
<th>Before Compression</th>
<th>After Compression</th>
<th>t’ value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean 10.1</td>
<td>Mean 13.26</td>
<td>47.883</td>
<td>0.000169</td>
</tr>
<tr>
<td>SD 1.44</td>
<td>SD 1.46</td>
<td></td>
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</tbody>
</table>

Table 2 : Mean Femoral Vein Diameter (in mm) on left side before & after abdominal compression (n=195)

DISCUSSION

Femoral vein is a reasonably accessible site for central venous access during resuscitation from an anatomical point of view. Though ultrasound guided techniques of central venous cannulation is getting better awareness, in developing countries like India, still blind techniques are followed in most of the places. More over the availability of the USG machine in ER and ICUs are not always possible.

Many studies in the past was done on Cross Sectional Area of femoral [CSA] vein in relation to proximal compression, But in our study we have seen the transverse diameter and not the cross sectional area of femoral vein. Paying more attention one can easily understand that increase in transverse diameter of femoral vein will obviously result in increased surface area for needle entry in femoral vein cannulation, hence missing the needle entry into femoral vein may be lesser.

This study shows that abdominal compression for 2 minutes significantly increases the transverse diameter of the femoral vein in stable adult patients admitted in emergency room and intensive care units. This study results are correlating well with previous studies (8, 11, 12). Kim et al., studied the effect of inguinal compression which increased the CSA of the femoral vein by 40%–56% in children compared with 35% increase in adults (8).

Looking at the results of the study abdominal compression can be applied before every femoral vein cannulation. Limitation of our study is that we could not quantify the amount of abdominal compression applied to the lower abdomen. Future studies may be aimed at cannulating femoral vein with abdominal compression using blind or USG guided technique.

CONCLUSION

Abdominal compression significantly increases the transverse diameter of femoral vein. The transverse diameter of right side femoral vein is larger than that of left side.

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