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LEUCOCYTOSIS AFTER POST TRAUMATIC SPLENECTOMY- A PHYSIOLOGICAL EVENT OR INDICATOR OF SEPSIS.

General Surgery

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ABSTRACT

Background: Blunt injury abdomen causes a variety of injuries, the commonest being solid organ injury. Among the solid organs, the spleen is most commonly injured. Operative management plays a major role in treatment of blunt injury abdomen. Various postoperative complications can occur following emergency laparotomy including surgical site infection, abdominal abscess, urinary tract infection and lower respiratory tract infection. Diagnosing these infections becomes particularly challenging following splenectomy because of the unusual physiological response to leucocyte count and platelet count. The aim of this study is to assess the three risk factors i.e Total Leucocyte Count, Platelet count/Total Leucocyte Count Ratio and Injury Severity Score in patients undergoing splenectomy and to compare them with other patients undergoing laparotomies other than splenectomy for blunt injury abdomen in order to achieve a cut off value beyond which persistence of leucocytosis may denote infection. **Aim and objectives:** To study the WBC Count and Platelet Count(PC)/WBC Count ratio in infected and non infected individuals who have undergone post traumatic splenectomy compared to other blunt abdomen trauma patients who have undergone laparotomy. To study the relationship of three prognostic factors : WBC count, PC/WBC count ratio and Injury Severity Score in individuals who have undergone emergency laparotomy after trauma and their role in post operative infection. **Materials and Methods:** This Observational study (Prospective) was conducted in Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai from June 2017 to October 2018. All patients undergoing splenectomy after trauma and other blunt trauma patients who underwent laparotomy were included in the study. Sample size is 30 cases of splenectomy. Parameters assessed were WBC count, platelet count, injury severity score, presence of post operative infections like pneumonia, abdominal abscess, septicaemia, urinary tract and wound infections. **Results:** The following are the results of the study.Injury severity score >21 is a significant risk factor. Post operative day 5 WBC count more than 15000 indicates infection. PC/TC ratio < 20 on the 5th post operative day indicates infection. Patients who underwent laparotomies other than splenectomy showed elevated Total count and Decreased platelet/total count ratio only if infected . Presence of more than 1 risk factor is associated with 72% chance of infection. **Conclusion:** Post operative day 5 is the earliest time that infected and non infected patients can be distinguished on the basis of total count and PC/TC ratio.Risk factors for infection includes Total count >15,000 on 5th post operative day,PC/TC ratio< 20 on 5th post operative day, ISS > 21. Presence of more than one risk factor carries 72% increased chance of infection and these patients should be monitored with high degree of suspicion.

KEYWORDS

Traumatic splenectomy; Leucocytosis; sepsis; platelet count; Injury severity score.

INTRODUCTION:

According to WHO by the year 2020, trauma will become the first or second leading cause of "loss of productive years of life" for both developed and developing countries.[1] Blunt abdominal trauma is the third most common form of injury in road traffic accidents and the victims mostly are young, productive adults and hence it has got enormous socioeconomic impact.[2] Mortality rates are higher in patients with blunt abdominal trauma than in those with penetrating wounds, because of the lack of early diagnostic facilities and optimal management[3] Blunt injuries are thought to result from a combination of crushing, deforming, stretching and shearing forces. The magnitude of these forces directly relates to the rate of their acceleration and deceleration as well as the relative direction of impact.[4] The spleen and liver are the most commonly injured solid organs. Injuries to pancreas, bowel and mesentery, bladder, and diaphragm, retroperitoneal structures like kidneys, abdominal aorta, are less common. Injuries to the kidney and urinary bladder may be associated with pelvic fractures and retroperitoneal hemorrhage .[5]

The spleen is the most commonly injured abdominal organ in trauma with 23.8% of abdominal trauma patients demonstrating splenic injuries. Many splenic injuries are self-limited, demonstrating no evidence of ongoing bleeding; others require splenectomy, which in most cases is straightforward. Despite this, the mortality after blunt splenic injury is 9.3%. Direct compression of the spleen with parenchymal fracture is the most common pathophysiologic mechanism followed by rapid deceleration.Spleen is the most commonly bleeding intra-abdominal organ, as noted in unstable patients with intra-abdominal fluid on focused assessment with sonography in trauma (FAST). Splenic injuries are identified during laparotomy in unstable patients taken to operating room emergently. In stable patients, the mainstay of diagnosing splenic injuries is by abdominal CT with IV contrast. Splenic injuries may appear as disruptions in the normal splenic parenchyma, with surrounding hematoma and free intra-abdominal blood. On occasion, active bleeding can be identified by visualizing extravasation of contrast material that appears as a high-density blush or accumulation of contrast-laden blood. Splenic injuries may also present as sub-capsular haematomas, pseudo-aneurysm or complete devascularisation at the hilum. Penetrating splenic trauma is less common but is still present in 8.5% of all penetrating abdominal injuries in the National Trauma Data Bank.

Splenic injuries are graded by the American Association for the Surgery of Trauma organ injury scaling system, which relies on the parenchymal or sub-capsular characteristics and the vascular involvement. Splenic injury patients who are hemodynamically stable may be managed by conservative management or by angiography and selective embolisation.

Blunt injury abdomen causes a variety of injuries, the commonest being solid organ injury. Among the solid organs, the spleen is most commonly injured. Operative management plays a major role in treatment of blunt injury abdomen. Various postoperative complications can occur following emergency laparotomy including surgical site infection, abdominal abscess, urinary tract infection and lower respiratory tract infection. Diagnosing these infections becomes particularly challenging following splenectomy because of the unusual physiological response to leucocyte count and platelet count.

MATERIALS AND METHODS:

This Observational study (Prospective) was conducted in Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai from June 2017 to October 2018. All patients undergoing splenectomy after trauma and other blunt trauma patients who underwent laparotomy were included in the study. Sample size is 30

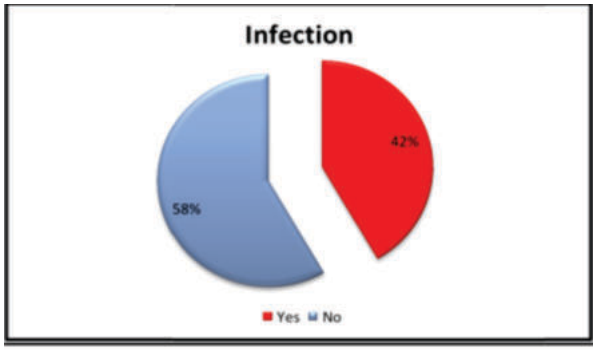
cases of splenectomy. Parameters assessed were WBC count, platelet count, injury severity score, presence of post operative infections like pneumonia, abdominal abscess, septicaemia, urinary tract and wound infections.

The aim of this study is to assess the three risk factors i.e Total Leucocyte Count, Platelet count/Total Leucocyte Count Ratio and Injury Severity Score in patients undergoing splenectomy. Conclusion will be drawn on the above parameters and all efforts to assess the parameters and comparison with patients undergoing laparotomies other than splenectomy in order to achieve a cut off value beyond which persistence of leucocytosis may denote infection.

RESULTS:

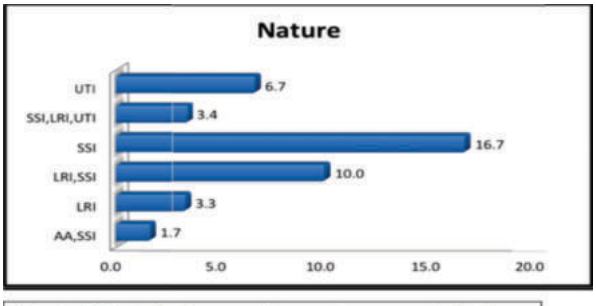
In our study there were a total of 41 males (68.3%) and 19 females (31.7%). The majority of study population was between 21-30 years. Out of 60 patients 35 were found to be non infected and 25 were diagnosed with post operative infection. Surgical site infection was the most common infection and 15.1% of infected individuals had more than one infection. The mortality rate observed in the study was 5%. The infected and non infected patients had similar counts till post operative day 5. After post operative day 5 the infected group had a total count of more than 15000 per cu.mm and a persistently higher total count than the non infected patients. Patients who underwent splenectomy had a consistently higher total count compared to those underwent other laparotomies. Patients who were infected found to have a lower platelet count ratio than non infected patients; the difference became statistically significant from 5th post operative day. (P/T ratio > 20).

Individuals with high injury severity score (ISS >21) were found to have a significantly higher risk of infection. Presence of more than one risk factor increased risk of infection by 72%. Even though infected and non infected splenectomy patients had higher than normal total counts, from 5th post operative day ,the non infected patients showed a steady decline in the value reaching high normal values on the post operative day 10 where as infected patients had continuous rise in total count.



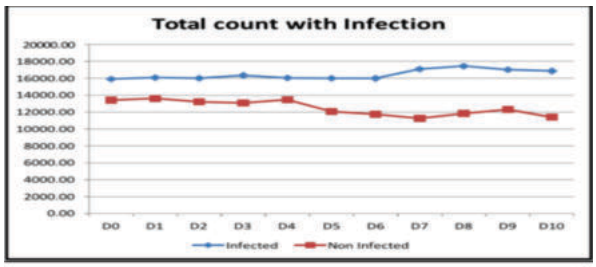
Out of 60 patients, 35 were found to be non infected and 25 were diagnosed with postoperative infection.

Graph 1 : Presence of infection.



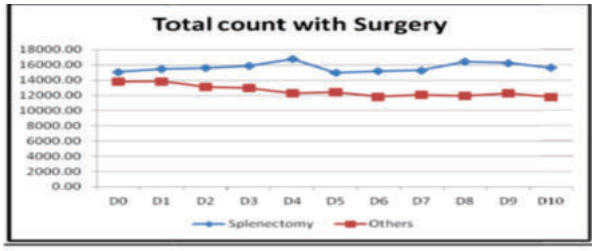
Surgical site infection was the most common infection and 15.1% infected individuals had more than one infection.

Graph 2: Nature of infection.



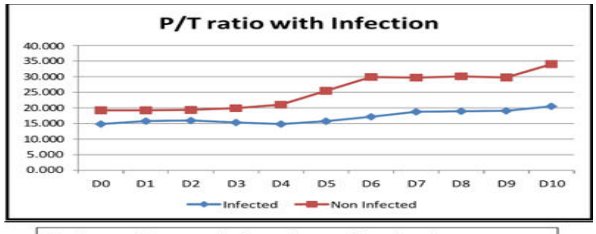
The infected and non-infected patients had similar counts till postoperative day 5. After post-operative day 5 the infected group had a total count > 15 x 10_3/ µL and a persistently higher total count than the non infected patients.

Graph 3: Total count in patients with infection.



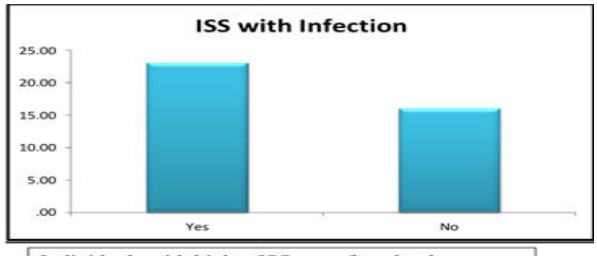
Patients who underwent splenectomy had a consistently higher total count compared to those who underwent other laparotomies

Graph 4: Total count in patients who underwent splenectomy.



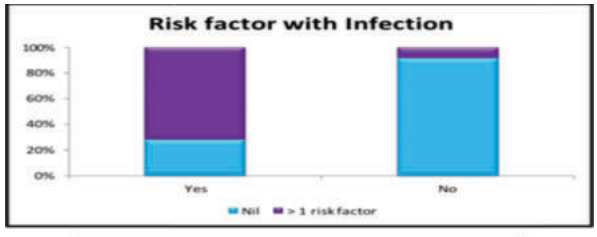
Patients who were infected were found to have a lower platelet count/Total count ratio than non infected patients: the difference became statistically significant from the 5th post operative day. (P/T Ratio <20)

Graph 5: Platelet– Total count ratio in patients with infection.



Individuals with higher ISS were found to have a significantly higher risk of infection (ISS>21)

Graph 6: significance of Injury severity score in infected individuals.



Presence of more than 1 risk factor increased risk of infection by 72%

Graph 7: significance of presence of more than one risk factor for infection.

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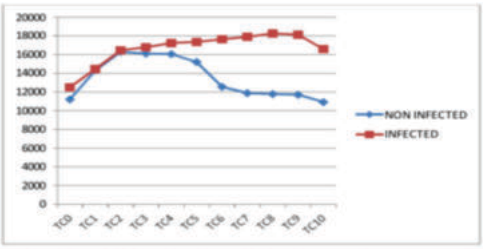
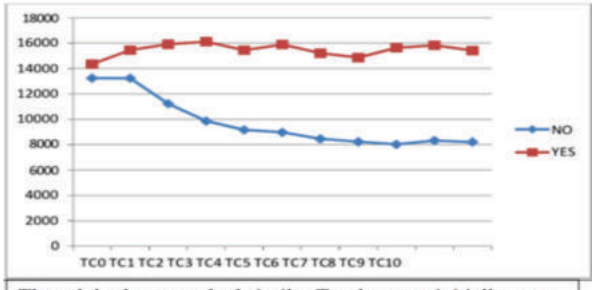


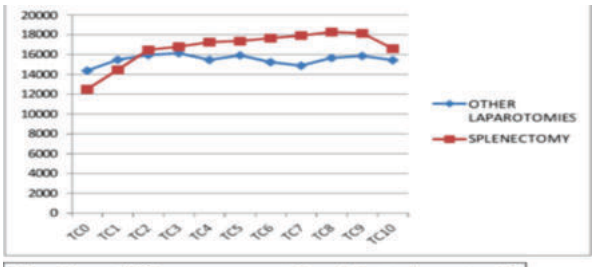
Even though both infected and non infected post splenectomy patients had higher than normal total counts, from the 5th post op day, the non infected patients showed a steady decline in the value reaching high normal values on the 10th post operative day, whereas infected patient's total counts continued to rise until treated. (Total count >15x 10^3 on POD 5 is significant)

Graph 8: comparison of total counts of infected vs non infected patients who under went splenectomy.



Though both groups had similar Total counts initially, non infected individuals had a steady fall of total count from post operative day 2.

Graph 9: Comparison of total counts; infected vs Non infected patients who underwent laparotomies other than splenectomy.



Significant difference was not found in total counts of infected individuals who underwent splenectomy vs other laparotomies.

Graph 10: comparison of total counts of infected patients who underwent splenectomy vs other laparotomies.

DISCUSSION:

The current study validates the three risk factors:1) Total count; 2)Platelet/ total count ratio; 3) Injury severity score for post-splenectomy infections in trauma patients compared to blunt abdomen injury patients who underwent laparotomies other than splenectomy.

A similar prospective study was published by Weng J, Brown CV, Rhee P, Salim A, Chan L, Demetriades D, Velmahos GC in the journal of trauma in May, 2005 but it did not compare splenectomy with other laparotomies. Injury severity score was significant in the current study whereas it was not found to be significant in the previous study. Another similar study published by Toutouzas KG, Velhamos GC, Kaminski A, Chan L, Demetriades D in 2002 in Jama surgery journal in August 2002, which took into consideration all three factors and found Injury Severity Score >16 to be an independent risk factor and presence of more than 1 risk factor predicted a 50% increased risk of infection . However in the current study, Injury Severity Score > 21 was found to be a risk factor and presence of more than one risk factor predicts a 72% increased risk of infection.

The following are the results of the current study:

1) Injury severity score >21 is a significant risk factor. 2) Post operative day 5 WBC count more than 15000 indicates infection. 3) PC/TC ratio < 20 on the 5th post operative day indicates infection. 4) Patients who underwent laparotomies other than splenectomy showed elevated Total count and Decreased platelet/total count ratio only if infected . 5) Presence of more than 1 risk factor is associated with 72% chance of infection.

The spleen is the most commonly injured abdominal organ in trauma with 23.8% of abdominal trauma patients demonstrating splenic injuries. Many splenic injuries are self-limited, demonstrating no evidence of ongoing bleeding; others require splenectomy, which in most cases is straightforward. Despite this, the mortality after blunt splenic injury is 9.3%. Direct compression of the spleen with parenchymal fracture is the most common pathophysiologic mechanism followed by rapid deceleration.Spleen is the most commonly bleeding intra-abdominal organ, as noted in unstable patients with intra-abdominal fluid on focused assessment with sonography in trauma (FAST). Splenic injuries are identified during laparotomy in unstable patients taken to operating room emergently. In stable patients, the mainstay of diagnosing splenic injuries is by abdominal CT with IV contrast. Splenic injuries may appear as disruptions in the normal splenic parenchyma, with surrounding hematoma and free intra-abdominal blood. On occasion, active bleeding can be identified by visualizing extravasation of contrast material that appears as a high-density blush or accumulation of contrast-laden blood. Splenic injuries may also present as sub-capsular haematomas, pseudo-aneurysm or complete devascularisation at the hilum. Penetrating splenic trauma is less common but is still present in 8.5% of all penetrating abdominal injuries in the National Trauma Data Bank. Splenic injuries are graded by the American Association for the Surgery of Trauma organ injury scaling system, which relies on the parenchymal or sub-capsular characteristics and the vascular involvement. Splenic injury patients who are hemodynamically stable may be managed by conservative management or by angiography and selective embolisation.

Mounting of an efficient immune response requires fast mobilization and distribution of lymphocytes. The kinetic aspects of lymphocyte trafficking is responsible for post splenectomy leukocytosis. Lymphocytes cross from blood across a specialized endothelium of post capillary venule into lymph node and exit via efferent lymphatics and thoracic duct.[19,20] Most lymphocytes circulate through spleen because direct access to marginal zone bypasses the specialized endothelium.The total lymphocyte pool in is estimated to be approximately $50*10^{10}$ cells of which $15*10^{10}$ circulate through lymphoid tissues[21]. At any given time only $1*10^{10}$ lymphocytes circulate in the blood with a short transit time of 20- 36minutes for exchangeable cells resulting in high turnover of migratory lymphocytes about 50 times per day[22,23] and total daily exchange of $50* 10^{10}$ between blood and tissues.The spleen has highest lymphocyte uptake of about 40% during the early stages of recirculation. [24]

During intermediate and late stages of recirculation, lymphocytes are predominantly found in lymph nodes. The transit time of migrating lymphocytes through the spleen is significantly shorter than through lymph nodes and a higher number of lymphocytes pass through the spleen than through the thoracic duct. Hence splenectomy results in a slower overall clearance of lymphocytes from peripheral blood. Moreover neutrophils are destroyed in spleen. Hence, splenectomy may result in neutrophilia. As a result of slower clearance of lymphocytes and reduced destruction of neutrophils, there is physiological leukocytosis post-splenectomy. Spleen is the major site where destruction of platelets takes place. Hence, there is physiological thrombocytosis following splenectomy.

CONCLUSION:

Post operative day 5 is the earliest time that infected and non infected patients can be distinguished on the basis of total count and PC/TC ratio. Risk factors for infection: 1) Total count >15,000 on 5th post operative day; 2) PC/TC ratio< 20 on 5th post operative day; 3)ISS > 21. Presence of more than one risk factor carries 72% increased chance of infection and these patients should be monitored with high degree of suspicion. Presence of increased total count and decreased platelet/total count on any post operative day in a patient who has undergone laparotomy other than splenectomy should be considered an indicator of infection and should be treated promptly.

Abbreviation:

ISS- injury severity score; PC-platelet count; TC- Total count; P/T ratio- platelet count/Total leukocyte count ratio; CT- computed tomography; FAST- Focussed assessment with sonography in trauma.

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Conflict of interest: The authors declare no conflict of interest.

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