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EVALUATION OF AUTOLOGOUS FIBRIN GLUE IN MANAGEMENT OF TRAUMATIC LIVER AND SPLENIC INJURIES

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A lot of literatures have insisted upon strict preservation of hepatic and splenic tissues in repair of their traumatic injuries. Among several procedures fibrin glue has been described as a topical haemostatic and sealant agent for traumatic hepatic and / or splenic injuries. The aims of the present study were [1] Assessment of the efficacy of autologous fibrin glue in the treatment of traumatic liver and splenic injuries. [2] Comparing fibrin glue therapy with conventional surgical methods. 55 patients, suffered from mild to moderate degrees of internal haemorrhage due to hepatic and/ or splenic injuries, were enrolled in the study. They were considered to be 60 cases, as 5 patients from them suffered from both liver and splenic injuries. They were divided into two groups: [1] Group I: included 32 cases of traumatic liver injury. They were classified into two subgroups: [A] Subgroup A: included 16 cases who were treated with fibrin glue application, and [B] Subgroup B: included 16 cases who were treated with conventional surgical methods. [2] Group II: included 28 cases of traumatic splenic injury. They were also classified into two subgroups: [A] Subgroup A: included 14 cases who were treated with fibrin glue application, and [B] Subgroup B: included 14 cases who were treated with conventional spleen - preserving surgery. The study revealed that: in all patients treated with autologous fibrin glue, there was no post-operative evidence of bleeding from the splenic or hepatic sites after autologous fibrin glue application by examination of the drains. Abdominal ultrasound examination showed no intraperitoneal haemorrhage or subphrenic collection. Examination of the hepatic and splenic sites by CT scanning revealed complete sealing of the fissures and the raw areas in liver and spleen within 2 to 3 weeks. So we can conclude that: fibrin sealing is feasible, effective and safe as conventional surgery for liver and splenic injuries.

Key words: Fibrin glue- Liver trauma - Splenic trauma - Splenorrhaphy.

INTRODUCTION

The liver and spleen are the most frequently injured organs due to blunt and penetrating abdominal trauma. Emergency laparotomy is crucial for early control of bleeding and to avoid posttraumatic delayed complications including secondary infection and delayed rupture of subcapsular haematomas [(1)].

A lot of literatures have insisted upon strict preservation of hepatic and splenic tissues in repair of their traumatic injuries. Although the spleen is not necessary for life as the liver is, it however, performs a variety of haematological and immunological functions that makes the preservation of splenic tissues in traumatic splenic injuries is of great importance [(2,3&4)].

Several procedures have been described as alternatives to excisional surgery in traumatic hepatic and / or splenic injuries including: conservative management, direct repair by simple suturing with Teflon buttresses, cocooning with a polyglycolic acid mesh, autotransplantation of splenic tissues and application of a topical haemostatic agents as fibrin glue [(5& 6)].

The Interest in the use of fibrin glue alone as a surgical sealant dates to the early 1900s. Cronkite et al. [1944] [(7)] were the first to combine fibrinogen and thrombin to facilitate skin grafting, but the unpredictable adhesive effects and the inability to concentrate fibrinogen contributed to infrequent use of this technique. Matras et al. [1972] [(8)] reintroduced the concept, and reported first

experience of fibrin glue application for nerve repair in experimental model. However, the improved technology of clotting factors preparation and concentration together with the highly advanced imaging modalities have facilitated the use of a fibrin glue as a biological adhesive sealant and haemostatic agent [9 & 10].

Fibrin glue is a highly concentrated form of human fibrinogen and clotting factors. It is used by applying a thin layer directly on to the injured surface or injecting it into or over a fractured surface. For knife or bullet tracts it can be injected deep into the base of the injury and slowly withdrawn. This distends the tract slightly to allow for both haemostatic and tamponade effects. The glue can also be used in association with sutures or alone to seal the hepatic or splenic surfaces after partial resection. It forms a firm, adherent coagulum with an affinity for moist surfaces. It has advantage over cyanoacrylate adhesive in that it is not histiotoxic, hypoallergenic, exciting little tissue reaction and is absorbed in 3 to 6 weeks [11&12].

There are two forms of fibrin glue: [1] The non-autologous fibrin glue (a commercially available, but it carries the risk of transmission of infection as hepatitis and HIV, in addition to the reported anaphylactic reaction) [13], and [2] The autologous fibrin glue (AFG) obtained from patient's own blood that eliminates the risk of disease transmission and provides a safe and relatively simple method to treat different surgical problems as traumatic liver and splenic injuries. Fibrin sealant is formed by mixing the blood product thrombin and fibrinogen in the presence of ca++ and factor XIII. The end product is a gel-like substance that can be used in surgery to achieve haemostasis and water-tight seal [14].

The aims of this study were [1] Assessment of the efficacy of autologous fibrin glue in the treatment of traumatic liver and splenic injuries. [2] Comparing fibrin glue therapy with conventional surgical treatment.

PATIENTS AND METHODS

The present study included 55 patients suffered from mild to moderate degrees of internal haemorrhage due to liver and/ or splenic injuries (they were considered to be 60 cases, as 5 of them suffered from combined liver and splenic injuries). Patients were admitted at Mansoura Emergency Hospital, Mansoura University, during the period between January 2000 and July 2002 (a total of 30 months). They included 36 males and 19 females (3 males and 2 females suffered from combined liver and splenic injuries). Their ages ranged from 8 to 53 years, with a mean age of 32.15 + 9.5 years. Patients with other associated abdominal injuries and patients who required splenectomy were excluded from the study. Patients of the present study were divided into two groups matched for age and sex.

[1] Group I: included 32 cases of traumatic liver injuries (27 patients suffered from isolated liver injuries and 5 patients suffered from combined liver and splenic injuries). They were classified into two subgroups:

[A] Subgroup A: included 16 cases who were treated with fibrin glue application, and

[B] Subgroup B: included 16 cases who were treated with conventional surgical methods.

[2] Group II: included 28 cases of traumatic splenic injuries (23 patients suffered from isolated splenic injuries and 5 patients suffered from combined liver and splenic injuries). They were classified into two subgroups:

[A] Subgroup A: included 14 cases who were treated with fibrin glue application, and

[B] Subgroup B: included 14 cases that were treated with conventional splenic- preservative surgery.

Preparation of Autologous fibrin glue: the adhesive was formed from two components:

1- COMPONENT I: formed by using Ammonium sulphate precipitation method under sterile condition (15). Twenty-seven ml of patient's blood was withdrawn before anaesthesia. The blood was mixed with 3 ml of sterile 10% sodium citrate solution, and centrifuged at 3200 round per minute for 10 minutes. The plasma was separated and added to 3.9 ml of cold sterile saturated solution of purified Ammonium sulphate, that resulting in immediate precipitation of fibrinogen. The tube was then centrifuged at 3200 round per minute for 3 minutes, and the whitish precipitate collected into another sterile tube. Just before application, the fibrinogen was diluted with 0.75 ml. of calcium chloride solution.

2- COMPONENT II: made by dissolving 9000 units of thrombin in 15 ml of sterile water (Thrombin- T, 4265; Plasma Sigma St. Louis, USA). Each component was then placed in the Duploject system (BRAUN, Melsungen AG - 1 Discofix, Vienna, Austria), which consists of two syringes connected to each other with a wide cannula (Fig. 1).

AFG- for repair of hepatic injuries (16 cases) and splenic injuries: (14 cases):

Twenty-seven ml of the patient's own blood was withdrawn before anaesthesia and used in preparation of autologous fibrin glue. During correction of the patient's general conditions, preparation of autologous fibrin glue was completed. At laparotomy, thorough abdominal exploration was performed to detect other causes of internal haemorrhage. Full mobilisation of the injured liver

or spleen was performed before any repair to assess the extent of damage.

For superficial liver and splenic tears (15 out of 30 cases) autologous fibrin glue was applied to the bleeding surface and fissures using the Duploject system. Four to five layers, at approximately 5 minutes intervals were utilised to stop bleeding without parenchymal sutures, (Fig. 2). It was applied with dry instruments and by sufficient amounts to cover the bleeding surface to a depth of several millimetres. Following application, pressure was applied for about 5 minutes.

For deep liver and splenic tears (8 out of 30 cases) AFG was injected deeply into the base of deep lacerated injuries and slowly withdrawn to allow for both haemostatic and tamponade effects.

For stellate lesions of the liver (3 out of 16 cases) pack was applied to reduce surface blood flow to mild or moderate ooze then AFG was applied. This was successful in one case, and segmental resection of the liver then AFG application, as a haemostatic agent, was needed in the other 2 cases.

AFG was also used after partial splenectomy (4 out of 14 cases) to seal the raw surface of the spleen.

Aspiration of all intraperitoneal blood was done. Then close observation of the injured organs had been performed for 15 minutes to be sure that the bleeding sources have been completely secured. The abdomen was closed leaving suction drains at the splenic (or hepatic) and pelvic sites. The drains were removed after 3 to 7 days.

Conventional surgery for repair of Hepatic injuries (16 cases):

= Small superficial tears (4 out of 16cases): repaired by interlocking sutures of Catgut or Vicryl.

= Deep tears (significant disruptions of the capsule and parenchyma)(7 out of 16 cases): repaired by deeply seated mattress sutures supported by a pad of omentum.

= Large stellate lacerations (5 out of 16 cases): treated by resectional debridement in 2 cases and segmentectomy in 3 cases.

Conventional surgery for repair of splenic injuries (14 cases):

= Small superficial tears (4 out of 14 cases): treated by suturing with Teflon buttresses.

= Deep tears (significant disruptions of the capsule and parenchyma) (4 out of 14 cases): treated by sutures that traverse the capsule and incorporate the parenchyma, supported by a pad of omentum.

= Extensive laceration or avulsion of one pole of the spleen (6 out of 14 cases): treated by partial splenectomy + mattress sutures supported by a pad of omentum.

Follow up: the follow up schedule included:

1- Drains observation every hour for early postoperative bleeding.

2- Blood examination for haematocrite value every 6 hours for 3 days to check up any red cell mass loss.

3- Ultrasound examination every 12 hours for 7 days to check up the sites of hepatic and/or splenic injuries and any haemoperitoneum. Then every day for 2 weeks to detect delayed rupture of subcapsular haematoma.

4- C.T. scanning after 2-3 weeks, to examine the injury sites.

RESULTS

During the period between January 2000 and July 2002 (a total of 30 months), 55 patients suffered from mild to moderate degrees of internal haemorrhage due to liver and / or splenic injuries were admitted at Mansoura Emergency Hospital, from them 27 patients (49.09%) suffered from isolated liver tear, 23 patients (41.81%) suffered from isolated splenic tear, and 5 patients (9.10 %) suffered from tear of both liver and spleen.

The average time for autologous fibrin glue preparation was 30 minutes. (Table 1) shows patient characteristics and characters of liver and splenic injuries in the studied groups. Liver and splenic injuries caused by stab wounds in 13 out of 60 (21.67%) of cases and blunt trauma in 47 out of 60 (78.33%) of cases. Right lobe of liver was affected in 22 out of 32 (68.75%) of hepatic injuries. While the left lobe was affected in the other 10 out of 32 (31.25%) of cases. Superficial tears of both liver and spleen were present in 23 out of 60 (38.34%) of cases. Deep tears were present in 19 out of 60 (31.66%) of cases. Avulsion or extensive laceration localised to one pole of spleen were present in 10 out of 60 (16.67%) of cases, while large stellate laceration of the liver were present in 8 out of 60 (13.33%) of cases. Associated injuries including fracture ribs were present in 9 out of 55 (16.36%) of patients.

(Table 2) showed the pre-operative clinical, laboratory and radiological findings in the studied groups. Serial decrease of the haematocrite value indicated continuous intraperitoneal bleeding was detected in 40 out of 60

(66.67%) of cases. Abdominal radiography demonstrated fracture ribs in 5 out of 60 (8.33%) of cases, elevation of the copula of diaphragm on right or left sides was present in 45 out of 60 (75%) of cases and enlarged splenic shadow in 20 out of 60 (33.33%) of cases. Abdominal ultrasound revealed free fluid in the peritoneum in all cases. Paracentesis revealed free blood in 52 out of 60 (86.67%) of cases.

At Laparotomy liver injuries in group of patients treated with autologous fibrin glue were superficial tears at diaphragmatic surface in 4 out of 16 (25%) of cases, superficial tears including diaphragmatic and anterior surfaces in 5 out of 16 (31.25%) of cases, deep tears in 4 out of 16 (25%) of cases and large stellate lacerations in 3 out of 16 (18.75%) of cases. It was matched with liver injuries in group of patients treated by conventional surgery {superficial tears at diaphragmatic surface in 3 out of 16 (18.75 %) of cases, superficial tears including diaphragmatic and anterior surfaces in one out of 16 (6.25%) of cases, deep tears in 7 out of 16 cases (43.75%), large stellate lacerations in 5 out of 16 (31.25%) of cases}, (Table 3 A).

Laparotomy also revealed that splenic injuries in group of patients treated by autologous fibrin glue were: superficial tears at diaphragmatic surface of spleen in 4 out of 14 (28.57%) of cases, superficial tears including diaphragmatic surface and anterior border in 2 out of 14 (14.29%) of cases, deep tears in 4 out of 14 (28.57%) of cases, and avulsion or destruction of the lower pole in 4 out of 14 (28.57%) of cases. It was matched with finding in group of patients treated by conventional surgery {superficial tears at diaphragmatic surface in 2 out of 14 (14.29%) of cases, superficial tears including diaphragmatic surface and anterior border in 2 out of 14 (14.29%) of cases, deep tears in 4 out of 14 (28.57%) of cases, and avulsion or destruction of the lower pole in 6 out of 14 (42.85%) of cases}, (Table 3 B).

(Table 4A): showed the type of surgical procedures performed for hepatic injured patients. In AFG- group: patients with superficial tears of the liver (9 out of 16 cases) were treated effectively by applying 4 to 5 layers of AFG at 5 minutes intervals. Patients with deep tears of the liver (4 out of 16 cases) were treated with AFG injection deep into the base of the injury and slowly withdrawn, to allow for both haemostatic and tamponade effects. Large stellate lacerations of the liver (3 out of 16 cases) were treated by packing + AFG in one case and by segmental resection + application of AFG as a haemostatic agent in the other 2 cases. In conventional surgery group: superficial tears of liver (4 out of 16 cases) were treated by interlocking sutures of catgut or Vicryl in 3 cases, and by deeply placed mattress sutures supported by a pad of omentum in one case. Deep tears of liver (7 out of 16 cases) were treated by deeply placed mattress sutures supported by a pad of omentum. Large stellate lacerations of the liver (5 out of 16 cases) were treated by resectional debridement with preservation of as much viable tissue as possible or segmentectomy.

(Table 4B): showed the type of surgical procedures performed for splenic injured patients. In AFG- group: patients with superficial tears of the spleen (6 out of 14 cases) were treated effectively by applying of 4-5 layers of AFG at 5 minutes intervals. Patient with deep tears of the spleen (4 out of 14 cases) were treated with AFG injection deep into the base of the injury and slowly withdrawn, to allow for both haemostatic and tamponade effects. Patients with avulsed or devitalised lower pole of the spleen (4 out of 14 cases) were treated with partial splenectomy + AFG to seal the splenic surface. In conventional surgery group: superficial tears of spleen (4 out of 14 cases) were treated by suturing with Teflon buttresses. Deep tears of spleen (4 out of 14 cases) were treated by deeply placed mattress sutures supported by a pad of omentum. Cases with avulsed or extensively damaged one pole of the spleen (6 out of 14 cases) were treated with partial splenectomy + mattress sutures supported by a pad of omentum.

(Table 5) shows postoperative course of patients treated with AFG in comparison to conventional surgical methods. Serial determination of the haematocrit value was around normal value, indicating no active bleeding in all patients treated with AFG. While 5 out of the 30 patients treated with conventional methods showed progressive decrease of haematocrite value with blood trickling from the drain, all of them were responding to the conservative treatment except one patient with hepatic injury who was in need for re-exploration, which revealed continuous surface oozing from the row surface of the liver for which segmental resection was performed. Also there was no post-operative evidence of bleeding from the splenic or hepatic sites after AFG application by examination of the drains and abdominal ultrasound examination showed no intraperitoneal haemorrhage or subphrenic collection. On the other hand one out of 30 patients treated with conventional surgery showed subphrenic collection, which was treated by drainage operation. Examination of the hepatic and splenic injured sites by CT scanning revealed complete sealing of the fissures and the raw areas in liver and spleen after 2-3 weeks (Fig. 3 & 4). No cases of delayed rupture of subcapsular haematoma were reported in all patients.

Table (1): ***Patients Characteristics:***

ITEMS	*LIVER INJURY GROUP*		*SPLENIC INJURY GROUP*		*TOTAL*
	Fibrin-glue Subgroup	Conventional surgery Subgroup	Fibrin-glue Subgroup	Conventional surgery Subgroup	
NUMBER OF CASES.	16	16	14	14	60 (55 patients)*
PATIENTS AGES (years):					
■ R			*8 – 53*		
a			*32.15 ± 9.5*		
PATIENT'S SEX					
-- Male/ Female.			36 /19 *		
INJURY:					
-- Isolated liver injury			27		
-- Isolated splenic injury			23		
-- Combined liver & splenic			5		
CAUSES:					
-- Stab wound.	3	5	2	3	13 (21.67%)
-- Blunt trauma.	13	11	12	11	47 (78.33%)**
SITE:					
-- Right lobe.	10	12			22 (68.75%)
-- Left lobe.	6	4			10 (31.25%)
PATHOLOGY:					
-- Superficial tears.	9	4	64	4	23 (38.34%)
--Deep tears.	4	7	0	4	19 (31.66%)
--Large stellate lacerations.	3	5		0	8 (13.33%)
--Extensive laceration of one pole of spleen.			4	6	10 (16.67%)
ASSOCIATED INJURIES:					
--Fracture ribs.		2		3	5
--Other Injuries.		2		2	4

* 5 Patients (3 males and 2 females) suffered from both liver and splenic injuries.

** 5 blunt trauma caused both liver and splenic injuries.

Table (2): ***Preoperative Clinical, Laboratory And Radiological Finding In The Study Group:***

CLINICAL & RADIOLOGICAL FINDING	*LIVER INJURY GROUP*		*SPLENIC INJURY GROUP*		*TOTAL*
	Fibrin-glue Subgroup	Conventional surgical Subgroup	Fibrin-glue Subgroup	Conventional surgical Subgroup	
TOTAL NUMBER OF CASES	16	16	14	14	60*
SIGNS OF INTERNAL HAEMORRHAGE	+	+	+	+	
HAEMATOCRITE VALUE	Progressive decrease in 40 patients (66.67%)				
ABDOMINAL AND CHEST X-RAY:					
= Fracture of right lower ribs					
= Elevation of copula of diaphragm		2		0	2 (03.33%)
= Fracture of left lower ribs					
= Enlarged splenic shadow		21		24	
		0		3	45 (75.00%)
		0		20	
					3 (05.00%)
					20 (33.33%)
Abdominal Ultrasound	Free fluid in all cases				
PARACENTESIS	Haemoperitoneum in 26 out of 32 cases		Haemoperitoneum in 26 out of 28 cases		52 out of 60 * (86.67%)

* 5 Patients suffered from both liver and splenic injury with positive paracentesis.

Table (3a): ***The Laparotomy Finding In Hepatic Injuried Group:***

Laparotomy Finding	*AFG Subgroup*				*Conventional Surgery Subgroup*			
	Number	Length	Depth	Condition at examination	Number	Length	Depth	Condition at examination
Total number		16				16		
Superficial tears at diaphragmatic surface	4	2-5 cm.	1-2 cm.	Mild bleeding	3	3-6 cm.	1-2 cm.	Mild bleeding
Superficial tears including diaphragmatic and anterior surfaces	5	8-10 cm.	1-2 cm.	Moderate Bleeding	1	6 cm.	2 cm.	Moderate Bleeding
Deep tears	4	2-7 cm.	2-3 cm.	Moderate bleeding	7	3-7 cm.	2-3 cm.	Moderate bleeding
Large stellate lacerations	3	2-10 cm.	2-3 cm.	Moderate bleeding	5	5-10 cm.	2-4 cm.	Moderate bleeding

Table (3b): ***The Laparotomy Finding In Splenic Injuried Group:***

Laparotomy Finding	*AFG Subgroup*				*Conventional Surgery Subgroup*			
	Number	Length	Depth	Condition at examination	Number	Length	Depth	Condition at examination
Number			14				14	
Superficial tears at diaphragmatic surface	4	3-5 cm.	1-2 cm.	Mild bleeding	2	3-6 cm.	1-2 cm.	Mild bleeding
Superficial tears including diaphragmatic surface and anterior border	2	5-7 cm.	1-2 cm.	Moderate bleeding	2	4-8 cm.	1-2 cm.	Moderate bleeding
Deep tears	4	4-9 cm.	2-4 cm.	Moderate bleeding	4	3-10 cm.	2-4 cm.	Moderate bleeding
Avulsion or destruction of the lower pole	4	4-10 cm.	-	Moderate bleeding	6	4-10 cm.	-	Moderate bleeding

Table (4a): ***Surgical Procedures Done For Hepatic Injuried Group:***

INJURIES	*AFG Subgroup*		*Conventional Surgery Subgroup*	
	Number	Technique	Number	Technique
Total Number	16		16	
Superficial tears at diaphragmatic surface	4	= Repair by applying of 4-5 layers of AFG at 5 minutes intervals.	3	= Repair by interlocking sutures of catgut or Vicryl.
Superficial tears including diaphragmatic and anterior surfaces	5		1	
Deep tears	4	= AFG injection into the base of the injury and slowly withdrawn	7	= Repair by deeply placed mattress sutures supported by a pad of omentum.
Large stellate lacerations	3	= Pack + AFG (one case) =Segmental resection + application of AFG as a haemostatic agent (2 cases).	5	= Resectional debridement with preservation of as much viable tissue as possible (2 cases). = Segmentectomy (3 cases).

Table (4b): ***Surgical Procedures Done For Splenic Injuried Group:***

INJURIES	*AFG Subgroup*		*Conventional Surgery Subgroup*	
	Number	Technique	Number	Technique
Total Number	14		14	
Superficial tears at diaphragmatic surface	4	= Repair by applying of 4-5 layers of AFG at 5 minutes intervals.	2	= Suturing with Teflon buttresses.
Superficial tears including diaphragmatic surface and anterior border	2		2	
Deep tears	4	= AFG injection into the base of the injury and slowly withdrawn	4	= Sutures that traverse the capsule and incorporate the parenchyma, supported by a pad of omentum
Avulsion or destruction of the lower pole	4	= Partial splenectomy + AFG to seal the splenic surface	6	= Partial splenectomy + mattress sutures supported by a pad of omentum.

Table (5): ***Postoperative Course In The Studied Group:***

POSTOPERATIVE COMPLICATION	*LIVER INJURY GROUP*		*SPLENIC INJURY GROUP*		*TOTAL*
	Fibrin-glue Subgroup	Conventional Surgery Subgroup	Fibrin-glue Subgroup	Conventional Surgery Subgroup	
Total number	16	16	14	14	60*
Haematocrite value	Normal	Decreased in 2 pat.	Normal	Decreased in 3 pat.	Decreased in 5 pat.
Haemorrhage from drain	No	2	0	3	5
Ultrasound examination	No Intraperitoneal haemorrhage	Intraperitoneal collection in 2 pat.	No Intraperitoneal haemorrhage	Intraperitoneal collection in 3 pat.	5
CT examination	Complete sealing of the fissures and the raw areas in the liver		Complete sealing of the fissures and the raw areas in the spleen		
Hepato-renal failure	0	2	0	2	4
Subphrenic collection	0	0	0	1	1
Delayed rupture	0	0	0	0	0
Transmission of viral hepatitis and aids	0	0	0	0	0

- Five patients suffer from both liver and splenic injuries.

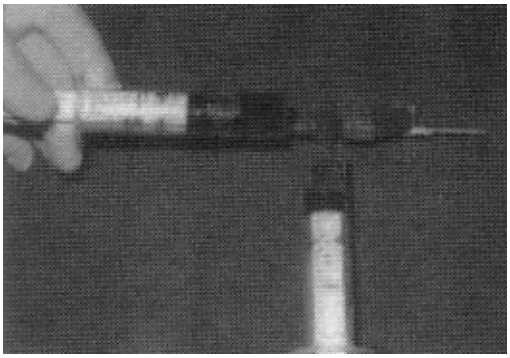

Fig. (1): Duploject System

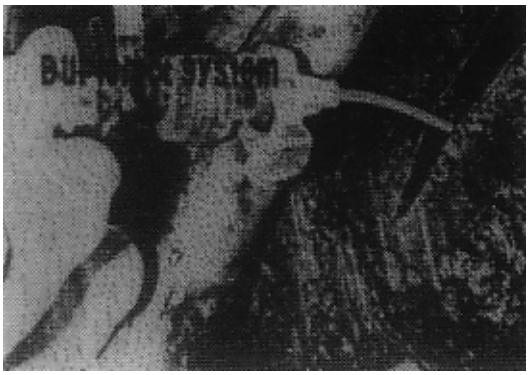

Fig. (2): AFG Application In A Splenic Fissure Through Duploject System

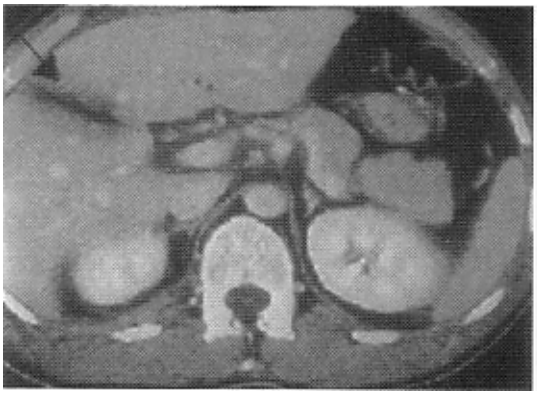

Fig. (3A): Hepatic Fissure

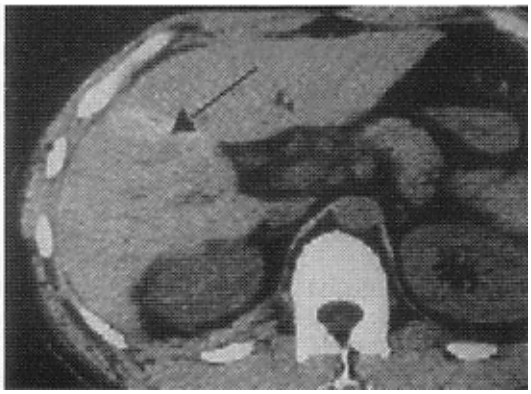

Fig. (3B): Sealed Hepatic Fissure Following A Stab Wound After AFG Application

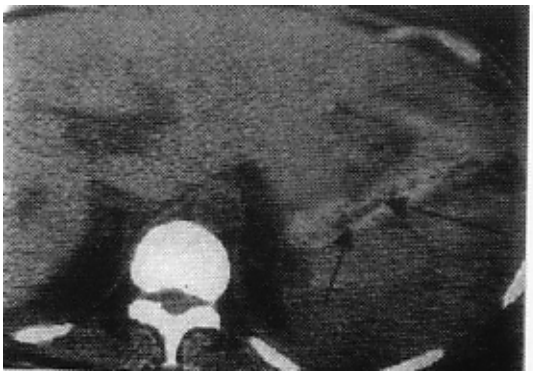

Fig. (4A): Splenic Parenchymal Laceration

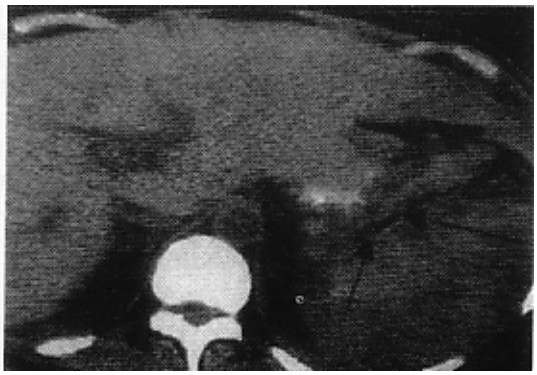

Fig. (4B): Sealed Splenic Laceration After AFG

DISCUSSION

Management of traumatic hepatic and splenic injuries has undergone tremendous evolution in the last 20 years aiming for preservation, as possible as can, of the functioning hepatic and splenic tissues.

Among the several advances in the preservative procedure, fibrin glue as a biological sealant was a matter of research and evaluation. In the present study 55 patients with internal haemorrhage, represented 60 cases of hepatic and splenic injuries, were classified into 30 cases of hepatic and splenic injuries who were treated with AFG as a preservative technique while the other 30 cases were treated with other conventional surgical procedures. Comparison between both groups revealed that in the AFG group the bleeding sources has been dramatically secured with no or minimal blood leak from the drain site. No postoperative collection in the peritoneal recesses with stable haematocrite value and early ambulation of the patients. Interestingly enough, effective haemostasis was achieved in 5 of our patients with AFG application inspite of having pre-existing bleeding tendency including coagulopathy and thrombocytopenia.

The time used in diagnosis, resuscitation, and laparotomy was compatible with the time used for preparation of autologous fibrin glue (average 30 minutes).

The results of the present study comes in agreement with the results of Ochsner[10] who stated that the advantages of AFG make it ideal adjunctive haemostatic agent in patients with intraabdominal solid organ injuries. Moreover control of haemorrhage from large stellate wounds of the liver and splenic salvage has been feasible with the aid of AFG.

The feasibility and easy applicability of AFG has introduced it as a biological sealing and haemostatic agent for control of intraperitoneal haemorrhage due to solid organ injuries during laparoscopic procedures. Salvino et al[9] have utilised AFG to arrest intraparenchymal abdominal haemorrhage in experimental models with encouraging results. Carbon et al [16] has utilised AFG for laparoscopic control of splenic haemorrhage in a series of 16 patients with very promising results.

Our results proved clearly that AFG offers a novel avenue for control of intraabdominal haemorrhage due to parenchymatous organ injury with a marvellous control of bleeding, great safety and feasibility. In our opinion among many preservative techniques described for management of hepatic and splenic trauma AFG has unique advantages [1] It is very efficient in achieving complete haemostasis. [2] It can be used effectively in deep hepatic and splenic lacerations without increasing the risk of continuous parenchymal bleeding, subcapsular haematoma formation or delayed rupture of subcapsular haematomas. [3] It is effective in patients with diseases related to coagulation disorders, as it does not depend on adequate platelet or clotting factors levels.[4] It can be useful in patients receiving heparin therapy and in patients with thromboasthaenia [5] The glue can also be used in association with sutures or alone to seal the hepatic or splenic surfaces after partial resection. [6] It is not histiotoxic, hypoallergenic and exciting little tissue reaction.

Our study also found good healing of the injuries after AFG application with no risk of transmitting viral or other infections. This agrees with Moore, 1984[17] who reported that: more than 85% of hepatic wounds can be managed by simple haemostatic techniques. However the effectiveness of AFG to control hepatic and splenic injuries depends primarily on the proper selection of patients suitable for such technique (superficial tears, deep tears and mild parenchymal lacerations). Moreover, careful postoperative monitoring is mandatory for early detection and management of rebleeding or other complications.

CONCLUSION

** Fibrin glue is a highly concentrated form of human fibrinogen and clotting factors that can be used with a great feasibility, effectiveness and safety as conventional surgery for treatment of liver and splenic injuries. For superficial tears it is used by applying a 4 – 5 layers at 5 minutes interval, while for deep tears it can be injected deeply into the base of the injury and slowly withdrawn to allow for both haemostatic and tamponade effects.

** AFG has clinical results superior to conventional surgery for management of hepatic and splenic injuries in terms of hospital stay and rapid return to normal activity. Moreover the operative trauma and postoperative complications were less frequent in fibrin sealing than in conventional surgery. AFG is highly effective in superficial tears, deep tears and mild parenchymal lacerations. So the successfulness of AFG as haemostatic and sealant agent depends on proper selection of patients suitable for such technique.

** AFG can be used as a biological sealing and haemostatic agent for control of intraperitoneal haemorrhage due to solid organ injuries during laparoscopic procedures.

REFERENCES

1. Uranus S.; Mischinger H.J.; Pfeifer J.; Kronberger L. ; Rabl H.; Werkgartner G.; Steindorfor P.; and Kraft- Kirz J. (1996): Haemostatic methods for the management of spleen and liver injuries. World J.Surg. Oct. 20 (8): 1107-1111.

2. Delaney H. M.; Porrecea F.; Mitsudeo S.; Solanki B.; and Budavsky D. [1982]: Splenic capping: an experimental study of a new technique for splenorrhaphy using woven polyglycolic acid mesh. Ann. Surg.; 196: 186-193.

3. Delgado Millan M.A.; and Deballon P.O. (2001): Computed tomography, angiography, and endoscopic retrograde cholangiopancreatography in the nonoperative management of hepatic and splenic trauma. World J. Surg. Nov.; 25 (11): 1397 – 1402.

4. Goffette P.P.; and Laterre P.F. (2002): Traumatic injuries: imaging and intervention in post-traumatic complications (delayed intervention). Eur. Radiol. May. ;12(5): 994 – 1021.

5. Ochsner MG; Maniscalco- Theberge ME.; and Champion H.R. (1990): Fibrin glue as a haemostatic agent in hepatic and splenic trauma. J. Trauma Jul. 30 (7) : 884- 887.

6. Jacops IA; Kelly K.; Valenziano C; Power J. and Jones C. (2001): Nonoperative management of blunt splenic and hepatic trauma in the paediatric populations; Am. Surg. Feb.; 67(2); 149 – 154.

7. Cronkite E. P.; Lozner E. L.; and Deaver J. M. [1944]: Use of thrombin and fibrinogen in skin grafting. JAMA; 124: 976-978.

8. Matras H.; Dinges H.P.; and Lassmann H. [1972]: Suture free interfascicular nerve transplantation in animal experiments. Wien Med. Wochenschr.; 122: 517 -523.

9. Salvino CK.; Esposito TJ; Smith DK; Jacebs HK; Candel AG; Ivelino D.; and Ganelli R. (1993): Laparoscopic injection of fibrin glue to arrest intraparenchymal abdominal haemorrhage: an experimental study. J. Trauma Nov.; 35 (5): 762 –766.

10. Ochsner M.G. (1998) : Fibrin solution to control haemorrhage in the trauma patients. J. Long term Eff. Med. Implants. 8 (2) :161-173.

11. Brands W.; Joppich W.; and Lochbuhler H. (1982): Use of highly concentrated human fibrinogen in paediatric surgery- a new therapeutic principle. Zkinderchir Apr.; 35 (4): 159-162.

12. Kram H.B.; Del Junco T.; dark SR, Ocampo HP; and Shoemaker WC. [1990]: Techniques of splenic preservation using fibrin glue. J. Trauma; 30: 97:101.

13. Milde L.N. [1989]: An anaphylactic reaction to fibrin glue. Analg.; 69: 684-689.

14. Kram R.B.; Shoemaker W. C.; Hino S.T.; and Harley D.P. [1989]: Splenic salvage using biologic glue. Arch. Surge.; 119: 1309- 1311.

15. Siedentop K.H.; Harris D.M.; and Sancher B. [1985]: Autologous fibrin tissue adhesive. Laryngoscope; 95: 1074- 1076.

16. Carbon R.T.; Baar S.; Waldschmidt J.; Hummer H.P.; and Simon S. (2001): Minimal invasive paediatric surgery: development and progress by innovative technology. Clinical Paediatric; May – June; 213 (3): 99-103.

17. Moore E.E. [1984]: Critical decision-making in management of acute hepatic injury. Am. J. Surg.; 148: 712-713.