

Research Article

Role of local instillation of one percent feracrylum and haemocogulase on wound healing

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ABSTRACT

Background: The introduction of increasingly complex and major surgical procedures during the last 50 years has inevitably been accompanied by greater problems in wound healing. Fortunately, modern surgery is relatively safe, certainly by comparison with situation 50 years ago, but it cannot be said that it is totally devoid of risks or complications, and problems of wound healing are encountered in every surgical specialty. Indeed, in various ways these complication account for a large part of morbidity and mortality of surgical treatment. The present study has been carried out to evaluate role of local instillation of 1% feracrylum and haemocoagulase on wound healing.

Methods: The present study was carried out in 100 patients in the Department of General Surgery, S.S. Medical College and associated G.M. Hospital and Sanjay Gandhi Memorial Hospital, Rewa (M.P.), India. The material for the study comprised of randomly selected 100 patients. A thorough clinical examination was done to assess general condition of patients and systemic disorder. Local examination was done to make a surgical diagnosis and associated problem. In case of surgical emergency, on arrival of patient clinical examination was immediately started and history asked during resuscitation of the patient. All relevant procedures were performed before surgery. Appropriate surgical procedures were performed. Suitable local haemostatic was applied. The wound inspected on 3rd, 7th and 14th day of presence of swelling, tenderness, colour change, discharge, scar tissue and changes were recorded.

Results: Most of the patients were between 21-30 years and 50 and above. The youngest being 3 years and the eldest being 75 years old. Majority of patients were operated for Perforation Peritonitis (28%) and Hernia (26%). Next common group was Intestinal Obstruction (9%) and Cholecystectomy (7%). Out of 100 cases operated 60 were as planned and rests were as emergency cases. 1% Feracrylum and Haemocoagulase was used in equal number of cases. In 24 cases 1% Feracrylum was instilled subcutaneously in 10 cases instilled at intermuscular level and in 16 cases instilled at both level. In 23 cases Haemocogulase was instilled subcutaneously in 14 cases instilled at intermuscular level and in 13 cases instilled at both level. All cases Skin Wound was closed in Interrupted fashion.

Conclusions: Good surgical technique plays key role in post-operative wound healing. The essential of good surgical technique include gentle handling of tissues, meticulous haemostasis, and prevention of dead space in the wound and avoidance of tissue necrosis resulting from excessive use of diathermy or strangulation of tissues by Ligatures. 1% Feracrylum and Haemocoagulase are helpful in decreasing local infection rate by decreasing post-operative capillary oozing.

Keywords: Feracrylum, Haemocogulase, Wound healing

INTRODUCTION

Wound heals by synthesis of connective tissue and the formation of a fibrous scar. Granulation tissue is the essential tissue of wound repair. It is highly vascular and cellular tissue in which the collagen and ground substance of connective tissue are synthesized, and the size of the final fibrous scar is proportional to the amount of granulation tissue formed.

Two type of repair in soft tissue wound are encountered by surgeons. primary wound healing occurs in incised wound when edges of the wound are apposed, the healing of such wound is described as primary union or union by first intention, and it is the type of wound repair encountered in the vast majority of surgical wounds. Secondary wound healing occurs in wounds in which the edges are widely separated either as a deliberate surgical policy or as a consequence of tissue loss or destruction.¹

The introduction of increasingly complex and major surgical procedures during the last 50 years has inevitably been accompanied by greater problems in wound healing. Fortunately, modern surgery is relatively safe, certainly by comparison with situation 50 years ago, but it cannot be said that it is totally devoid of risks or complications, and problems of wound healing are encountered in every surgical specialty. Indeed, in various ways these complication account for a large part of morbidity and mortality of surgical treatment.

The factors, which may adversely affect wound healing, can be conveniently considered in two categories local and systemic factor. Local factors are – Surgical technique, Blood supply, mechanical stress, suture material, suture technique radiation, infection. While systemic factors are – Age, malnutrition, vitamin deficiency, zinc deficiency, trauma, hypovolaemia, hypoxia, anaemia, uremia, malignant disease, jaundice, corticosteroids, cytotoxic and antimetabolite drugs.²⁻⁸ The present study has been carried out to evaluate role of local instillation of 1% feracrylum and haemocoagulase on wound healing.

METHODS

The present study was carried out in 100 patients in the Department of General Surgery, S.S. Medical College and associated G.M. Hospital and Sanjay Gandhi Memorial Hospital, Rewa (M.P.), India. The material for the study comprised of randomly selected 100 patients during the period from July 2001 to March 2002. Ethical considerations were met through institutional ethical committee. Each patient was informed and consent was taken.

Patients admitted in routine or emergency were thoroughly interrogated for personal bio-data, age, sex, occupation presenting complaints, detailed present

history, past illness, family history, associated systemic disorder and previous treatment received.

A thorough clinical examination was done to assess general condition of patients and systemic disorder. Local examination was done to make a surgical diagnosis and associated problem. In case of surgical emergency, on arrival of patient clinical examination was immediately started and history asked during resuscitation of the patient. Principles of emergency management were followed rigidly keeping in view patency of airway, breathing and circulation of patient. Priorities were fixed and intravenous route established immediately. Collection of blood sample was done and starting the required fluids and antibiotics as indicated by surgical problem.

Patients were investigated either previously or after admission with special reference to haemoglobin, blood group and relevant investigations according to clinical diagnosis like X-ray, Ultrasonography, Biopsy and prepared for Surgical intervention as required. All details were recorded as mentioned in proforma.

All patients were operated under suitable anesthesia. All the instruments and material used in the operation were sterilized prior to surgery by autoclaving. The sharp instruments were sterilized by Lysol solution. The suture material used was available in presterilized packs. The operative site was shaved wherever necessary and then treated with Savlon, Betadine solution and Spirit. Finally the operation site was draped with sterilized towels.

During closure of wound 1% Feracrylum (it is a water soluble ferrous salt of Polyacrylic Acid. It is not absorbed in systemic circulation due to its high molecular weight. It is a local haemostatic. Its haemostatic effect is based on the formation of synthetic complex consisting of it's adduct with plasma proteins principally albumin. The preparation used was HEMOLOK manufactured by Themis Chemicals Ltd.) or Haemocogulase (it is purified enzyme complex isolated from the venom of Brazillian Snake Bothrops Atox. It promotes and accelerates the physiological process of haemostasis. The preparation used was REPTILASE manufactured by Troikaa Pharmaceuticals Ltd.) was instilled at different level of wound i.e. subcutaneous, intermuscular or both subcutaneous and intermuscular with the help of a sterilized disposable syringe. Wounds were sutured and dressed with Provodine Iodine ointment.

The wound inspected on 3rd, 7th and 14th day of presence of swelling, tenderness, color change, discharge, scar tissue and changes were recorded. Data was compiled in MS-Excel and checked for its completeness and correctness. Then it was analyzed.

RESULTS

It is evident from below table that most of the patients were between 21-30 years and 50 and above. The youngest being 3 years and the eldest being 75 years old. (Table 1, Figure 1).

Table 1: Distribution of patients according to age and sex.

Age group (in yrs)	Male	%	Female	%	Total cases	Total
00-10	11	11	2	2	13	13
11-20	12	12	3	3	15	15
21-30	16	16	5	5	21	21
31-40	13	13	6	6	19	19
41-50	6	6	6	6	12	12
50 and above	18	18	2	2	20	20
Total	76	76	24	24	100	100

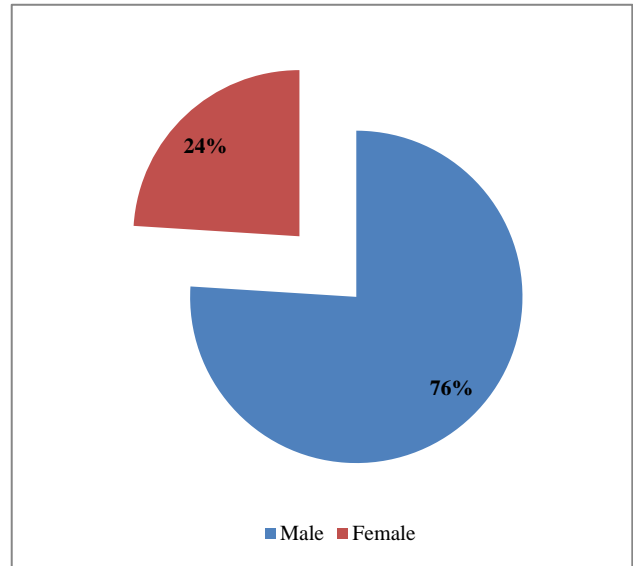


Figure 1: Sex wise distribution of study subjects.

Table 2: Distribution of patients according to indication of surgery.

Sr.no.	Operations	Total Cases	%	Drug Instilled Locally			
				1% Feracrylum		Haemocogulase	
				No.	%	No.	%
1	Exp. Lap For Perf. Peritonitis	28	28	15	15	13	13
2	Inguinal Herniorrhaphy	20	20	10	10	10	10
3	Exp. Lap. For Intestinal Obstruction	9	9	3	3	6	6
4	Cholecystectomy	7	7	4	4	3	3
5	Inguinal Herniotomy	6	6	1	1	5	5
6	Appendectomy	4	4	0	0	4	4
7	Supra-public Cystolithotomy	4	4	3	3	1	1
8	Simple Mastectomy	3	3	3	3	0	0
9	Exp. Lap. For Trauma	2	2	1	1	1	1
10	Exp. Lap. For Ca. Stomach	2	2	0	0	2	2
11	Eversion of Sac	2	2	2	2	0	0
12	Exp. Lap. For Excision of Hydatid Cyst	1	1	0	0	1	1
13	Exp. Lap. For Ca. Gall Bladder	1	1	0	0	1	1
14	Supra-pubic Prostatectomy	1	1	1	1	0	0
15	Cleft Lip Repair	1	1	1	1	0	0
16	Z-Plasty	1	1	1	1	0	0
17	Recanalisation	1	1	1	1	0	0
18	Circumcision	1	1	0	0	1	1
19	Superficial Parotidectomy	1	1	1	1	0	0
20	Epigastric Herniorrhaphy	1	1	1	1	0	0
21	Incisional Herniorrhaphy	1	1	1	1	0	0
22	Pyelolithotomy	1	1	0	0	1	1
23	Excision of Thyroid Nodule	1	1	0	0	1	1
24	Excision of Sebaceous Cyst Scalp	1	1	1	1	0	0
	Total	100	100	50	50	50	50

It is evident from above table that majority of patients were operated for Perforation Peritonitis (28%) and Hernia (26%). Next common group was Intestinal Obstruction (9%) and Cholecystectomy (7%) (Table 2).

It is evident from below tables that out of 100 cases operated 60 were as planned and rest were as emergency cases (Table 3, Figure 2).

Table 3: Distribution of patients according to planned and emergency surgery.

Procedure	Number of cases	Percentage
Planned	60	60
Emergency	40	40
Total	100	100

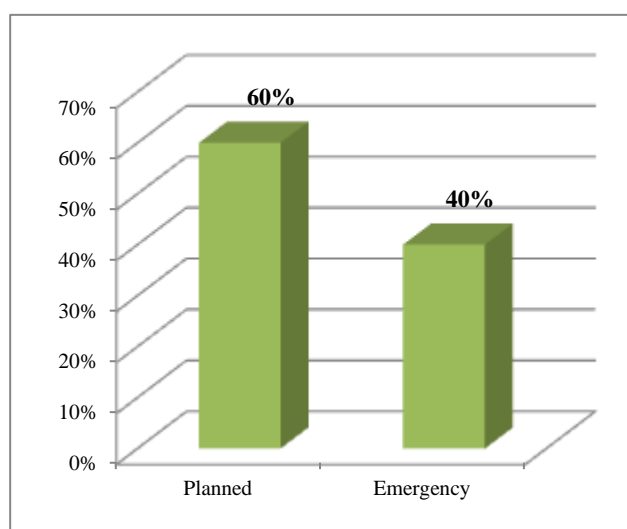


Figure: 2 Distribution of patients according to planned and emergency surgery.

Table 4: Distribution of patients according to nature of anaesthesia.

Anaesthesia	Number of cases
General Anaesthesia	73
Spinal Anaesthesia	22
Local Anaesthesia	05
Total	100

It is evident from above table that majority of cases were operated under General Anesthesia (73), Spinal Anesthesia was used in 22 cases, whereas 5 cases were operated under Local Anesthesia (Table 4).

Table 5: Distribution of patients according to 1% Feracrylum and Haemocoagulase instilled locally.

Drug	Number of Cases	Percentage
1% Feracrylum	50	50
Haemocoagulase	50	50
Total	100	100

It is evident from above table that 1% Feracrylum and Haemocoagulase was used in equal number of cases (Table 5).

It is evident from below table that in 24 cases 1% Feracrylum was instilled subcutaneously in 10 cases instilled at intermuscular level and in 16 cases instilled at both level (Table 6).

Table 6: Distribution of patients according to different level of instillation of 1% Feracrylum.

Level of instillation	No. of cases
Subcutaneous	24
Intermuscular	10
Both (S.C. +I.M.)	16
Total	50

Table 7: Distribution of patients according to different level of instillation of Haemocogulase.

Level of instillation	No. of cases
Subcutaneous	23
Intermuscular	14
Both (S.C. +I.M.)	13
Total	50

It is evident from above table that in 23 cases Haemocogulase was instilled subcutaneously in 14 cases instilled at intermuscular level and in 13 cases instilled at both level (Table 7).

Table 8: Distribution of patients according to closure of skin wound.

Closure of skin wound	No. of cases
Interrupted	100
Total	100

It is evident from above table that in all cases Skin Wound was closed in Interrupted fashion (Table 8).

Table 9: Distribution of patients according to local and systemic antibiotic used.

Number of Cases	Systemic Antibiotic used	Local Antibiotic used	Antibiotic not used
100	100	100	0
Total (100)	100	100	0

It is evident from above table that in all cases both systemic and local antibiotic was used (Table 9).

It is evident from below table that all signs and symptoms of wound healing gradually decreased in the follow-up period (Table 10).

Table 10: Distribution of cases according to symptomatology of wound healing when 1% Feracrylum was instilled locally at different level.

Condition of wound	Drug Instilled 1% Feracrylum								
	Subcutaneous N=24			Intermuscular N=10			Both N=16		
	3 rd day	7 th day	14 th day	3 rd day	7 th day	14 th day	3 rd day	7 th day	14 th day
Tenderness	24	2	2	10	3	2	16	3	1
Swelling	14	3	2	3	3	2	7	2	1
Discharge	3	6	2	3	3	2	3	4	1
Healed	-	18	22	-	7	8	-	12	15

Table 11: Distribution of cases according to symptomatology of wound healing when Haemocoagulase was instilled locally at different level.

Condition of wound	Drug instilled Haemocoagulase								
	Subcutaneous N=23			Intermuscular N=14			Both N=13		
	3 rd day	7 th day	14 th day	3 rd day	7 th day	14 th day	3 rd day	7 th day	14 th day
Tenderness	23	2	1	14	2	0	13	1	0
Swelling	10	2	1	4	1	0	5	1	0
Discharge	2	2	1	0	1	0	0	1	0
Healed	-	21	22	-	13	14	-	12	13

It is evident from below table that all signs and symptoms of wound healing gradually decreased in the follow-up period (Table 11).

DISCUSSION

All morphological and chemical events of wound healing leads to a single important conclusion, that wound become stronger with time.

Rate of strength gain and the ultimate strength of wounds determine what local and systemic factors affect wound healing. Strength gain in incised wound begins immediately after suturing. The rate of gain in strength increases rapidly after 3rd days with the appearance of collagen fibers. Skin wound continue to gain strength at a relatively rapid and constant rate for over 4 month and at a slower rate for over a year. Muscle and fascial wounds gain strength slowly. In spite prolonged strength gain, wounds rarely, if ever, regain the strength of normal tissues. Abdominal wounds gain only 20% of original strength of the tissue on 7th day. In addition strength is not the only parameter of scar. Normal elasticity is equally important, as tissue function is lost in scars.

One of the studies from India showed that Haemocoagulase after minor oral surgery not only provides faster haemostasis but also enhances healing.⁹ Bleeding at the surgical site is very disturbing both for the patient and the surgeon. There are several conventional haemostatic techniques to minimize blood loss. Mechanical means include manual pressure, ligature and the application of a tourniquet. However, these methods can be labour intensive and add time to the operative procedure.¹⁰ Sealing of bleeding vessels can also be achieved by thermal methods such as electro cauterization or laser cauterization, but these create areas of char and necrotic tissue, increasing the likelihood of infection and damaging wound edges. This may lead to impaired healing¹¹ conventional methods are also less effective in controlling bleeding from complex injuries and where access to the area of bleeding is difficult. Topical haemostatic agents may be particularly useful in such situations.

Several topical haemostatic agents are currently available in a range of configurations. They exert their effect in a variety of ways. Some improve primary haemostasis, whereas other stimulates fibrinolysis.¹² Some are a preparation of a procoagulant substance in combination with a vehicle such as collagen matrix. Others use a

matrix to provide a template for the endogenous coagulation cascade to achieve haemostasis. Factors affecting the selection of an appropriate topical haemostat include the type of procedure, cost, severity of bleeding, and the personal experience and preference of the surgeons.

Dr. Babu S. Parmar, Dr. Samir mansuri in 2006¹³ done a study and stated that use of haemocoagulase after surgery not only provides faster hemostasis but also enhances healing by rapid formation of healthy tissue and reducing the amount of infection which may alter the normal healing process.

Feracrylum is an incomplete ferrous salt (II and III) of polyacrylic acid, which acts as a topical haemostatic agent, for use in control of oozing in various surgical procedures.¹⁴ It also possesses antimicrobial properties and decreases the postoperative infection. Its mode of action is via activation of thrombin, which subsequently causes conversion of fibrinogen to fibrin and thus clots formation. In addition, feracrylum combines with blood proteins, especially albumin and forms a gel-like substance, which forms a physical barrier on wound surface and stops capillary bleeding and oozing¹⁵ Feracrylum has molecular weight of 500,000-8000,000 Daltons because of which it is not getting absorbed systemically and has no adverse effects on the liver, kidney, adrenals, cardiovascular and haemopoietic systems.¹⁶ The effectiveness of feracrylum in hypospadias surgery has been studied in only one study done by Lohati et al.¹⁷ However, it has never been compared with a traditional drug. Studied evaluating the use of this novel haemostatic agent in laparoscopic cholecystectomy, gastrointestinal bleeds, obstetric haemorrhage, reducing postoperative sarcoma formation in mastectomy have been conducted; however, large-scale and multicenter trials are mandatory to establish its efficacy in wider spectra of procedure.¹⁸

Symptomatology of wound healing when 1% Feracrylum was instilled at different level

When 1% Feracrylum instilled at subcutaneous level (n=24)

1. Tenderness: - On 3rd day tenderness was present in all cases, on 7th day and 14th day it was detected in only 2 cases.
2. Swelling: - It was found to decrease with time. On 3rd day it was present in 14 cases, on 7th day in cases while on 14th day it was detected only in 2 cases.
3. Discharge: - It was detected in 3 cases on 3rd day, in 6 cases on 7th day and only in 2 cases on 14th day. It decreased in follow-up period.
4. Healing: - In 18 cases wound healed on 7th day, on 14th day wound healed in 22 cases.

When 1% Feracrylum instilled at intermuscular level (n=10)

1. Tenderness: - It was present in all cases on 3rd day. It was present in 3 cases on 7th day and on 14th day it was present only in 2 cases.
2. Swelling: - It was present in 3 cases on 3rd day, in 3 cases on 7th day and in 2 cases on 14th day.
3. Discharge: - It was present in 3 cases on 3rd day, in 3 cases on 7th day and in 2 cases on 14th day.
4. Healing: - On 7th day wound healed in 7 cases. On 14th day wound healed in 8 cases and in 2 cases wound healing was impaired.

When 1% Feracrylum instilled at both level (n=16)

1. Tenderness: - It was present in all cases on 3rd day. In 3 cases on 7th day and in 1 case on 14th day.
2. Swelling: - It was present in 7 cases on 3rd day, in 2 cases on 7th day and in 1 case on 14th day.
3. Discharge: - It was present in 3 cases on 3rd day, in 4 cases on 7th day and in 1 case on 14th day.
4. Healing: - On 7th day wound healed in 12 cases and on 14th day wound healed in 15th cases. Healing was impaired in 1 case.

When Haemocoagulase was instilled at Subcutaneous level (n=23)

1. Tenderness: - It was present in all cases on 3rd day. In 2 cases on 7th day and in 1 case on 14th day.
2. Swelling: - It was present in 10 cases on 3rd day, in 2 cases on 7th day and in 1 case on 14th day.
3. Discharge: - It was present in 2 cases on 3rd day, in 2 cases on 7th day and in 1 case on 14th day.
4. Healing: - Wound healed in 21 cases on 7th day, in 22 cases on 14th day Healing was impaired in 1 case.

When Haemocoagulase was instilled at intermuscular level (n=14)

1. Tenderness: - It was present in all cases on 3rd day. In 1 case on 7th day it was absent in all cases on 14th day.
2. Swelling: - It was present in 4 cases on 3rd day, in 1 case on 7th day and absent in all cases on 14th day.
3. Discharge: - It was absent in all cases on 3rd day, in 1 case on 7th day and absent in all cases on 14th day.
4. Healing: - Wound healed in 12 cases on 7th day and in all cases on 14th day.

When Haemocoagulase was instilled at both level (n=13)

1. Tenderness: - It was present in all cases on 3rd day, In 1 case on 7th day absent in all cases on 14th day.
2. Swelling: - It was present in 5 cases on 3rd day, in 1 case on 7th day and absent in all cases on 14th day.

3. Discharge: - It was absent in all cases on 3rd day, present in 1 case on 7th day and absent in all cases on 14th day.
4. Healing: - Wound healed in 12 cases on 7th day and in all cases on 14th day.

Out of 16 cases, in which 1% Feracrylum was instilled at both level (S.C. +I.M.) wound gapping was present in 1 case at the time of discharge.

Out of 24 cases, in which Haemocogulase was instilled at Subcutaneous level wound gapping was present in 1 case at the time of discharge.

Wound of cases, in which Haemocogulase was instilled at Intermuscular and Both (S.C. +I.M.) level healed at the time of discharge.

CONCLUSION

On the basis of study, following conclusions were made:

- 1 When 1% Feracrylum or Haemocogulase was instilled at subcutaneous, intermuscular and both level (S.C. +I.M.) tenderness and swelling gradually decreased in follow-up period. Discharge was noticed in few cases in the early post-operative period. Majority of wound healed by the end of 14th day.
- 2 Good surgical technique plays key role in post-operative wound healing. The essential of good surgical technique include gentle handling of tissues, meticulous haemostasis, and prevention of dead space in the wound and avoidance of tissue necrosis resulting from excessive use of diathermy or strangulation of tissues by Ligatures.
- 3 Both local and systemic infections have adverse effect on wound healing. Systemic infection is treated by appropriate antibiotic and correction of other systemic problems like anaemia, uremia, nutritional deficiency etc.
- 4 1% Feracrylum and Haemocoagulase are helpful in decreasing local infection rate by decreasing post-operative capillary oozing (as blood is good culture media).
- 5 1% Feracrylum forms Haemostatic complex with albumin of plasma, this haemostatic complex has got antibacterial activity against many gram positive and gram negative microorganisms and against pathogenic fungi.

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