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REVIEW ARTICLE

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Improving the Results of Surgical Treatment of Abscessed Cellulitis of the Fingers and Toes in Patients with a Moderate and High Risk of Thromboembolic Complications Developing

Sonis A.G., Stolyarov E.A., Alekseev D.G.*, Bezrukova M.A., Ladonin S.V.
Samara State Medical University (Russia, Samara)

ABSTRACT

The article presents the experience of low molecular weight heparins usage in outpatient general surgery in compromised patients, namely with abscessed cellulitis of the fingers and toes affected by moderate and high risk of thromboembolic complications developing. The results of the study indicate that the low molecular weight heparins usage in patients with abscessed cellulitis of the fingers and toes affected by moderate or high risk of thromboembolic complications significantly reduces the chances and the probability of purulonecrotic complications in the area of intervention in the early postoperative period (OR = 4.32, RR = 3.60). Also, in this category of patients on the back of low molecular weight heparins usage significantly enhanced chances and probability (OR = 5.60, RR = 4.73) of the favorable treatment outcomes development are observed, consisting in the safekeeping of fingers (toes) and its functional activities.

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Finger and toe, abscessed cellulitis, surgical treatment, thromboembolic complications, chances and risk, low molecular weight heparins.

INTRODUCTION

In terms of the prevalence and duration of temporary disability, cellulitis of fingers and toes occupies one of the leading places in outpatient surgery [6, 8]. The main principle of the treatment of abscessed cellulitis is surgical; two parallel linear side incisions on the affected surface of the diseased finger are perform and penetrating drainage is conducted [3, 11]. Against the background of the treatment, the surgical wounds cleansed and heal quickly enough, which contributes to a good blood supply to the fingers (toes). Four arteries enter each finger and toe with the formation of a developed capillary network and numerous anastomoses at the level of venules and arterioles. The mesotenon's vessels also enter finger or toe in its palmar or plantar side [5, 14].

However, if patients have moderate or high risks of the thromboembolic complications (hereinafter - TEC) developing, the risk of an unfavorable course of the wound process in the early postoperative period increases significantly [12]. Against the background of the intervention and surgical trauma, local vasoconstriction, edema caused vascular compression, formed elements sludge are enhanced, up to the formation of blood microclots [1, 10]. Acidosis and ischemia are developed in tissues, which lead to damage and even death (necrosis) of tissues [7, 9].

In large surgery, for the prevention of thrombosis in the perioperative period, fractionated or low molecular weight heparins (hereinafter - LMWH) — heparin derivatives with a molecular weight from 2.000 to 10.000 Daltons are actively used [4, 13]. Its pharmacokinetic properties are determined by the anti-Xa factor activity changing in plasma, what causes high antithrombotic potential of LMWH [2]. At the same time, the effectiveness of the use of LMWH in ambulatory purulent surgery has not been sufficiently studied.

The aim of the study was to improve the results of surgical treatment of abscessed cellulitis of the fingers and toes in patients with a moderate and high risk of TEC developing through perioperative usage of LMWH.

* Contact Alekseev D.G i Samara State Medical University (Russia, Samara)
sashsas63@googlemail.com ORCID: 0000-0003-4185-0709

METHODOLOGY

The study, which was conducted from March 2018 to March 2020, involved 87 patients with cellulitis of the fingers and toes (ICD-10 diagnosis code - L03.0). The study inclusion criterion was the presence of cellulitis of the fingers or toes in the patient, affected by moderate or high risk of TEC developing.

The study exclusion criteria were:

cellulitis of the fingers or toes on the back of risk's absence or low risk of TEC developing;

cellulitis of the fingers or toes with already existing complications of a thromboembolic and necrotic nature (thrombophlebitis of the limb, gangrene of the finger etc.) when seeking medical help;

cellulitis of the fingers or toes with injuries or purulent-inflammation diseases in the proximal parts of limbs (wrist, foot);

chronic anticoagulants usage at the time of seeking medical help.

The treatment of abscessed cellulitis of the fingers and toes of all the study participants was carried out by surgery in an outpatient department. Two parallel incisions were made along the lateral surfaces of the finger (toe), on the palmar (plantar) side of it. Only the skin was dissected acutely, subcutaneous tissue was stratified stupidly with a clamp. Next, skin-subcutaneous flaps were moved in different directions and necrectomy was performed by curettage with a Volkmann's small spoon. After necrectomy, the wounds were washed with antiseptic solutions. The operation was completed by draining of wounds by penetrating lamellar drainage. Interventions were performed under conduction anesthesia according to the Oberst method (when the process was localized on the distal or middle phalanges) or the Brown method (when the process was localized on the proximal phalanx). Further dressings in both groups were performed once a day - until the end of the outpatient treatment. The basis for case closing was the complete cleansing of the wound from necrosis, purulent discharge, fibrin and its implementation with granulation tissue.

In addition to surgical intervention, patients underwent conservative measures to correct concomitant pathology. Depending on the volume of these measures, all study participants formed two comparison groups. In the main group (37 people), concomitant pathology was corrected without perioperative administration of LMWH due to the presence of contraindications to its usage in patients (intolerance, hemorrhagic gastritis, thrombocytopenia, etc.). In the comparison group (50 people), concomitant pathology correction was performed together with the usage of LMWH in the perioperative period. All patients in this group were injected with enoxaparin sodium subcutaneously in the umbilical region - on the day of surgery in 2-4 hours before it began, and then 1 time a day until clinical case closing. For patients with a moderate risk of TEC developing, enoxaparin sodium was administered at a dose of 0.2 ml., with a high risk – at a dosage of 0.4 ml.

The study was a prospective clinical observation with the assessment and analysis of the following key parameters in the early postoperative period:

Dynamics of differences in average local temperature (hereinafter - ΔT) on the affected and contralateral healthy finger (toe). For temperature measurements a portable thermal imager with a division value of 0.05°C was used. The difference was considered significant if the temperature difference between the fingers (toes) being compared exceeded the measurement error of the apparatus, which was 0.1°C. Measurements were taken at the time of seeking medical help, after surgery, and then every day until the average local temperature in the operated and contralateral healthy finger (toe) became comparable. In this case, the temperature difference between the fingers (toes) being compared was less than the measurement error of the apparatus. Evaluation of the duration of ΔT persistence made it possible to evaluate the functional state of the arterial bed (arterioles, precapillaries) of blood circulation in the affected finger.

Dynamics of the difference in circumference (hereinafter - ΔL) of the affected and contralateral healthy finger at the level of the causal phalanx. For measuring the circumference, an encompassing ruler (circometer) was used with a division value of 1 mm. The difference was considered significant if the difference in circles between the fingers being compared exceeded the measurement error of the apparatus, which was also 1 mm. The measurements were carried out when seeking medical help, after surgery and then every day until the average circumference in the affected and healthy finger became comparable. In this case, the difference in circumference between the fingers being compared was less than the measurement error of the device. Estimation of the duration of ΔL persistence made it possible to assess the condition of the venous bed (postcapillaries and venules) and venous outflow from the finger into the proximal parts of limbs.

The frequency of purulonecrotic complications in the area of intervention (wound necrosis) in the early postoperative period, requiring postprimary surgical debridement.

The average duration of an outpatient case in each of the comparison groups.

Direct treatment outcomes - thus attributed to favorable outcomes episodes healing of surgical wounds on the fingers (toes) without complications restrict its functional activity or leading to loss of

finger (toe) or phalanx. Adverse outcomes included the development of complications in the form of tendon necrosis, destruction of interphalangeal or metacarpophalangeal joints and loss of functional activity of the finger (toe), as well as the development of deep necrosis, which required amputation of the finger (toe) or phalanx.

The next step was to compare the data obtained between groups using descriptive statistics methods. Relative values, average values and errors of average values were calculated. To determine the statistical significance of differences in average values when comparing samples, Student's criterion was used; to compare two relative indicators - Fisher's exact test. Differences between values were considered statistically significant at $p \leq 0.05$. We also calculated the indicators provided by the principles of evidence-based medicine: the number of patients needed to treat (NNT), as well as the odds ratio (hereinafter - OR) and relative risk (hereinafter - RR) with the calculation of the boundaries of the 95% confidence interval (hereinafter - CI).

RESULTS

According to the results of the study, the following data were obtained. The comparison groups were comparable by age ($p \geq 0.05$): 53.06±2.16 years in the main group and 52.29±2.11 years in the comparison group, and also comparable by sex ($p \geq 0.05$): in the main group there were 7 (22.6%) women and 30 (77.4%) men, and in the comparison group, respectively, 10 (20.0%) and 40 (80.0%) women and men. The groups were also comparable in any other parameter

s that could affect the result of the study (profile of concomitant pathology, bad habits, etc.).

Acute (injection, cut) or chronic (abrasion, compression) microtrauma was the producing cause of the finger's and toe's cellulitis development of all study participants. The average terms for seeking medical help in the main group were 3.26+0.82, and in the comparison group - 3.98+1.02 days from the moment of injury. Differences are not statistically significant ($p \geq 0.05$). The distribution of patients according to the localization of the purulent-inflammatory process was as follows. In the main group of 37 patients, 27 people (73.0%) had subcutaneous and 10 (27.0%) cutaneous-subcutaneous localization of the inflammation focus. In the comparison group of 50 patients, 36 people (72.0%) had a subcutaneous form, and 14 people (28.0%) had a cutaneous-subcutaneous localization of the inflammation focus.

Cellulitis of the fingers took place in the main group in 22 (59.5%), and toes in 15 (40.5%) of 37 patients; in the comparison group, in 29 (58.0%) and 21 (42.0%) of 50 patients respectively. In the wrist second finger was most often affected - 11 (50.0%) patients in the main and 14 (48.3%) patients in the comparison group. Then, according to the frequency of lesions, there were first finger - 9 (40.9%) episodes in the main and 12 (41.4%) episodes in the comparison group and third finger - 2 (9.1%) and 3 (10.3%) episodes respectively. There were no patients with lesions of fourth and fifth fingers in our study. On the feet, first toe was affected in 12 (80.0%) patients of the main and in 16 (76.2%) patients in the comparison group, then fifth fingers in 3 (20.0%) and 5 (23.8%) patients respectively. No lesions of other toes were noted. Episodes of lesions of two or more fingers or toes, as well as finger lesions on both hands (toes on both feet) were not observed in any of the groups.

Most of the study participants - 28 (75.7%) people in the main and 40 (80.0%) people in the comparison group, called severe pain (including at night) in the affected finger the reason that prompted to see a doctor. In 9 (24.3%) patients of the main and 10 (20.0%) of the comparison group, the reason for contacting the surgeon was the forced restriction of professional activity and the need of sick leave execution.

When seeking medical help, the difference in average temperature (ΔT) between the affected and healthy contralateral finger (toe) by more than 0.1°C was found in all participants of the study. This difference was manifested in local hyperthermia of the affected finger (toe) and persisted after surgery. According to the results of observations, the average terms for leveling ΔT in the main group amounted to 1.45±0.14 days, in the comparison group - 1.41±0.11 days. The difference is not statistically significant ($p \geq 0.05$). Also, when seeking medical help, all participants revealed a difference in the circumference (ΔL) between the affected and healthy contralateral fingers (toes). This difference was manifested in local edema and an increasing of the circumference of the affected finger (toe) by more than 1 mm. and persisted after the intervention. The average terms for leveling ΔL in the main group were 6.32±0.66 days, in the comparison group - 4.03±0.58 days. The difference is statistically significant ($p \leq 0.05$).

Purulonecrotic complications in the area of intervention (wound necrosis) in the early postoperative period, requiring postprimary surgical debridement, developed in 8 (21.6%) of the 37 patients in the main group, and only 3 (6.0%) of 50 patients in the comparison group. The difference between the groups for this indicator was statistically significant ($p \leq 0.05$). The OR indicator was 4.32 (OR>1). Thus, the chances of necrosis in the surgical wound area were lower in patients of the comparison group. The observed dependence was statistically significant ($p \leq 0.05$), since CI95% did not include 1 (the value of its lower boundary was 1.06 and the upper one was 17.61). The RR

score was 3.60, indicating a lesser probability of developing necrosis in the wound after surgery in patients of the comparison group. This relationship was also statistically significant (p≤0.05), since CI95% did not include 1 (the value of its lower boundary was 1.03 and the upper one was 12.67).

The average duration of an outpatient surgical treatment of cellulitis of the fingers or toes in the main group was 12.48±1.12 days, in the comparison group - 18.64±1.07 days. The difference between the groups for this indicator was statistically significant (p≤0.05).

A favorable direct outcomes of the treatment in the main group were observed in 30 (81.1%) of 37 patients; in the comparison group in 48 (96.0%) of 50 patients. Adverse treatment outcomes were observed, respectively, in 7 patients (8.1%) of the main group and in 2 patients (4.1%) of the comparison group. The differences were statistically significant in both cases (p≤0.05). At the same time, adverse outcomes in the main and comparison groups developed in patients who had complications in the form of wound necrosis in the early postoperative period. In the main group, adverse treatment outcomes were represented by flexor tendon necrosis (4 episodes (57.1%) of 7), interphalangeal joint destruction (2 episodes (28.6%) of 7), and dry distal phalanx necrosis (1 episode (14, 3%) of 7) with its subsequent amputation. In the comparison group, adverse treatment outcomes were reported in both episodes by tendon necrosis.

Considering the outcomes of treatment, the increase in relative benefits when using LMWH was 18.4%, the absolute - by 14.9%; reduction in relative risk - 15.5%, absolute - 14.9%. The index of NNT was equal to 7 patients. The OR parameter was 5.60 (>1). The chance of favorable direct outcomes developing was higher in patients of the comparison group. The observed dependence was statistically significant (p≤0.05), since the CI95% did not include 1 (the value of its lower boundary was 1.09, and the upper one was 28.76). The RR score was 4.73, which indicates a higher probability of developing favorable direct outcomes in patients of the comparison group. This relationship was also statistically significant (p≤0.05), since the CI95% did not include 1 (the value of its lower boundary was 1.04, and the upper one was 21.47).

DISCUSSION

According to the results of the study, it can be noted that in patients with cellulitis of the fingers or toes, affected by moderate or high risk of TEC developing, the underlying disease, as well as the surgical intervention, do not significantly affect (p≥0.05) on the blood supply of the finger (arterial bed), as in the case of prophylactic use of NMWH, and without it, as evidenced by the thermographic picture. At the same time, this category of patients in the postoperative period reliably (p≤0.05) has a longer persistence of local edema of the affected finger (toe), in the absence of perioperative use of LMWH. This circumstance may indicate a violation of the venous outflow in the affected finger due to thrombotic lesions of this circulatory area. Accordingly, a higher risk of the development of purulonecrotic complications (wound necrosis) in the early postoperative period in this category of patients, against the background of the lack of perioperative use of LMWH, is associated with the development of venous thrombosis and edema in the affected finger, followed by compression of the arterial vessels, primarily in mesotenon. In turn, local purulonecrotic complications cause the development of adverse treatment outcomes, manifested in tendon necrosis with limited functional activity of the fingers or even total necrosis of the finger (toe) tissue and the necessity of amputation.

CONCLUSIONS

The LMWH usage in the perioperative period in patients with cellulitis of the fingers or toes affected by moderate and high risk of TEC reliably (p≤0.05) helps to reduce the chances and the probability of local purulonecrotic complications developing requiring postprimary surgical debridement in the area of the surgical wound (OR = 4.32, RR = 3.60). Against the background of the usage of LMWH, reliably (p≤0.05) the term of relief of local edema in the postoperative period and duration of the case of outpatient treatment are reduced. Also, in this category of patients, on the back of LMWH usage, there are significantly (p≤0.05) higher chances and probability (OR = 5.60, RR = 4.73) of the favorable treatment outcomes development consisting in safekeeping of fingers (toes) and its functional activities.

REFERENCES

1. Adnan Prsic, Jeffrey B Friedrich. Postoperative Management and Rehabilitation of the Replanted or Revascularized Digit. Hand Clinics. – 2019. – Vol. 35. – Iss. 2. – P. 221-229. [link]
2. Bradley J. Peters, Mikaela Hofer, Craig E. Daniels, Jeffrey L. Winters. Effect of Plasma Exchange on Antifactor Xa Activity of Enoxaparin and Serum Levetiracetam Levels. American Journal of Health-System Pharmacy. – 2018. – Vol. 75. – Iss. 23. – P. 1883–1888. [link]
3. Caitlyn M. Rerucha, John T. Ewing, Kathryn E. Oppenlander, Wesley Charles Cowan. Acute Hand Infections. American Family Physician. – 2019. – Vol. 99. – Iss. 4. – P. 228-236. [link]
4. Carlo Rostagno. Prophylaxis of Venous Thromboembolism in Major Orthopedic Surgery: A Practical Approach. Cardiovascular &

Hematological Agents in Medicinal Chemistry. – 2013. – Vol. 11. – Iss. 3. – P. 230-242. [link]
5. Fabio J. Pencle, Muhammad Waseem. Fingertip Injuries. StatPearls [Internet]. – 2020. URL: https://www.ncbi.nlm.nih.gov/books/NBK436006/
6. Garrett Blumberg, Brit Long, Alex Koyfman. Clinical Mimics: An Emergency Medicine-Focused Review of Cellulitis Mimics. The Journal of Emergency Medicine. – 2017. Vol. 53. – Iss. 4. – P. 475-484. [link]
7. Haruka Nakada, Masayuki Inoue, Kazushige Furuya, Hideki Watanabe, Kou Ikegame, Yuko Nakayama, Masato Ohmori & Hiroshi Nakagomi. Fat necrosis after breast-conserving oncoplastic surgery. Breast Cancer. – 2019. – Vol. 26. – P. 125–130. [link]
8. Jérôme Pierrart, Damien Delgrande, William Mamane, Daniel Tordjman, Emmanuel H Masmejean. Acute Felon and Paronychia: Antibiotics Not Necessary After Surgical Treatment. Prospective Study of 46 Patients. Hand Surgery and Rehabilitation. – 2016. – Vol. 35. – Iss. 1. – P. 40-43. [link]
9. Landesberg Giora, London J. Martin. The Enigma of Postoperative Troponin Elevation. Anesthesia & Analgesia. – 2016. – Vol. 123. – Iss. 1. – P. 5-7. [link]
10. Monica A. Bray, Sarah E. Sartain, Jahnavi Gollamudi, Rolando E. Rumbaut. Microvascular thrombosis: experimental and clinical implications. Translational Research. – 2020. – P. 1-26. [link]
11. Naomi M. Nardi, Edward J. McDonald, Timothy J. Schaefer. Felon. StatPearls [Internet]. – 2020. URL: https://www.ncbi.nlm.nih.gov/books/NBK430933/
12. Russian clinical recommendations on diagnostics, treatment and prevention of venous thromboembolic complications (VTEO). «Flebologiâ» (Phlebology). – 2015. – Vol. 9(2). – Iss. 4. – P. 4-46. [link]
13. Xin Lu, Jin Lin. Low Molecular Weight Heparin Versus Other Anti-Thrombotic Agents for Prevention of Venous Thromboembolic Events After Total Hip or Total Knee Replacement Surgery: A Systematic Review and Meta-Analysis. – 2018. – Vol. 19. – Iss. 1. – P. 322. [link]
14. Yohan Choi, Charles Cox, Kevin Lally, Yong Li. The strategy and method in modulating finger regeneration. Regenerative Medicine. – 2014. – Vol. 9. – Iss. 2. – P. 231-242. [link]