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Research Article

FEATURES OF CLINICAL AND LABORATORY PRESENTATIONS OF PURULENT SURGICAL DISORDERS AFFECTING SOFT TISSUES IN THE CONTEXT OF DIABETES MELLITUS AND DIFFUSE TOXIC GOITER

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ABSTRACT

In the context of concurrent endocrine conditions such as diabetes mellitus and diffuse toxic goiter, managing patients with purulent surgical soft tissue diseases presents notable challenges. This study aimed to explore the clinical characteristics of purulent surgical soft tissue diseases in the presence of diabetes mellitus and the combination of diffuse toxic goiter. Patients were divided into two groups: Group I comprised individuals with purulent surgical soft tissue diseases and diabetes mellitus, while Group II included patients with purulent surgical soft tissue diseases alongside a combination of diabetes mellitus and diffuse toxic goiter. The examination of patients with purulent-necrotic soft tissue diseases alongside comorbidities like diabetes mellitus and diffuse toxic goiter revealed distinct features in the wound healing process: parameters related to organism intoxication, wound cleansing, and healing duration tended to normalize at a slower pace in Group II compared to Group I, with a lag of approximately 2 days. The average duration of bed rest for Group II was 10 ± 1.4 days, whereas in Group I, it was 8 ± 1.5 days.

KEYWORDS

purulent surgical diseases, diabetes mellitus, diffuse toxic goiter.

INTRODUCTION

As per the International Diabetes Federation (IDF) data, the global diabetic population currently stands at 415 million individuals, with projections indicating a surge to 642 million by 2040 [1]. Given this escalating prevalence of diabetes, acquiring accurate insights into the health status of affected individuals (including complication development, life expectancy, disability, etc.) is paramount [2;3]. The establishment of data collection and management mechanisms is facilitated by the utilization of the "Diabetes Register" [4]. This register functions as an automated information and analytical system designed for nationwide diabetes monitoring, involving continuous patient observation from registration onwards and tracking treatment dynamics [5].

In parallel, thyroid disorders rank prominently among all endocrine maladies [6]. This prominence is chiefly attributed to the widespread occurrence of diffuse goiter in regions marked by iodine deficiency, encompassing vast territories within the Russian Federation and numerous other nations, including Uzbekistan [7]. According to WHO guidelines, the daily inorganic iodine requirement is set at 150 mcg. Inadequate iodine intake (below 50 mcg/day) precipitates diminished hormone synthesis in the thyroid gland, culminating in goiter formation and eventual hyperthyroidism [8].

Managing purulent surgical ailments in diabetic patients presents a pressing surgical challenge [9]. Particularly when accompanied by severe endocrine disorders like diabetes and diffuse toxic goiter, treating patients with purulent surgical soft tissue diseases becomes notably arduous. The body experiences myriad deviations from its normal physiological state, including disruptions in carbohydrate, mineral, and protein metabolism, all of which detrimentally affect the body's reparative processes—integral to addressing purulent soft tissue diseases [10].

METHODS

The records from the evaluation and therapy of 147 patients with purulent soft tissue wounds stemming from various causes were scrutinized. These patients received treatment at the purulent surgical department of the clinical facility affiliated with the Bukhara State Medical Institute between 2011 and 2020 [11].

All individuals were categorized into two cohorts based on their treatment regimen: Group I encompassed patients with purulent soft tissue surgical ailments within the context of diabetes mellitus, while Group II comprised patients with purulent soft tissue surgical ailments alongside a combination of diabetes mellitus and diffuse toxic goiter [12].

Among the 107 patients examined, 76 (70.9%) exhibited purulent wounds originating from diverse etiologies, while 31 (29.1%) presented with purulent postoperative wounds (Figure 1). Upon admission, all patients' wounds were in the initial stage of the wound healing process [13].

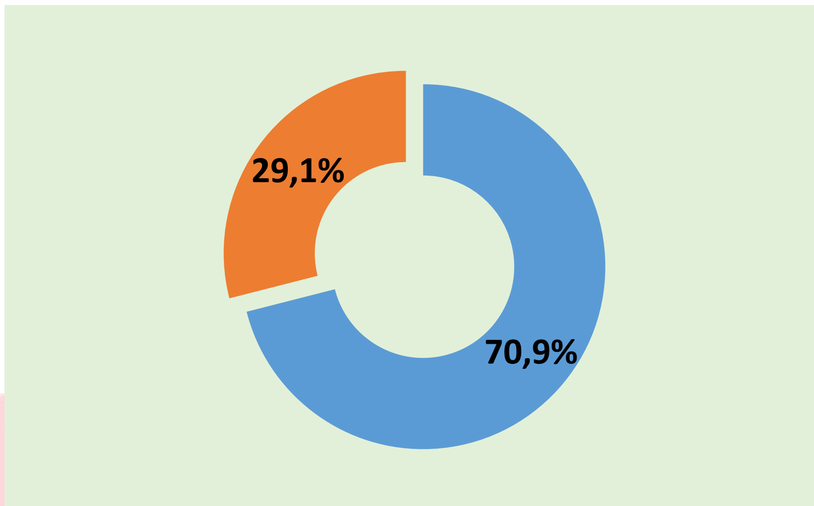

Figure 1: Distribution of patients in Group I according to etiological factors.

Upon admission, the overall condition of patients was largely moderate in severity. Clinical and laboratory findings revealed predominant indications of systemic intoxication, including elevated body temperature or persistent subfebrile state, pallor, restricted mobility, tachycardia with weak pulse, increased erythrocyte sedimentation rate (ESR), leukocytosis, and a left shift in white blood cell count. Additionally, local disease manifestations were evident, such as erythema, edema, and tissue induration surrounding the wound site. Palpation elicited deep and tender infiltration, while patients with postoperative purulent complications exhibited copious purulent discharge upon suture removal.

For all patients in Groups I and II diagnosed with purulent soft tissue diseases, incision and drainage of the purulent focus were promptly performed upon admission. Subsequent to necrectomy and wound debridement using antiseptic agents (including 3% hydrogen peroxide solution, 0.02% furacilin solution, and application of a 25% dimethyl sulfoxide solution), local treatment involved gauze dressings impregnated with levomekol ointment based on a water-soluble medium. Concurrently, systemic antibiotic therapy was administered, tailored to the sensitivity profile of microflora isolated from the wounds, alongside detoxification and symptomatic management.

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Normalization of blood sugar and thyroid hormone levels in the examined patients was achieved through collaborative efforts with an endocrinologist.

Various clinical, laboratory, and instrumental investigative methods were employed. Objective assessment of both systemic and local disease manifestations relied on subjective indicators (e.g., nature of wound discharge, resolution of induration, condition of wound edges, characteristics of granulation tissue and epithelialization) and objective signs (e.g., body temperature, complete blood count, leukocytic index of intoxication, concentration of medium-molecular peptides in serum, pH of wound discharge, calculation of the proliferative capacity according to M.F. Mazurik, percentage reduction in wound surface area, wound healing rate, bacteriological and cytological analyses).

The leukocytic index of intoxication (LII) was determined using the formula devised by Y.Y. Kalf-Kalif. The wound healing rate was assessed utilizing the methodology proposed by L.N. Popova, which entails covering the wound with a sterilized transparent film and marking its boundaries. Subsequently, the marked image is transferred onto millimeter paper to precisely determine the wound area, with repeat assessments conducted after one day to calculate the percentage reduction in wound area relative to the previous measurement.

$$S = \frac{(S - Sn) \cdot 100}{S \cdot t}$$

Where S is the previous wound area, Sn is the current wound area, and t is the number of days between the first and subsequent measurements.

Microbiological examination involved collecting samples of wound exudates, which were then subjected to both qualitative and quantitative analysis to assess wound infection and its susceptibility to various antibiotics.

Cytological imprints were prepared using the technique developed by M.P. Pokrovsky and M.S. Makarov. Following the removal of necrotic tissue and pharmaceutical remnants, 2-3 imprints were obtained from the same site. The cellular composition was quantified as percentages, with cell counts ranging from a hundred to 250-300 cells in different regions of the specimen to accurately gauge process dynamics.

The prognostic coefficient (PC) for the wound healing process was calculated using the formula devised by M.F. Mazurik in 1984.

$$PC = \frac{TPP \ \text{(total plasma protein)}}{TWEP \ \text{(total wound exudate protein)}}$$

In the course of the study, pH-metry of wound exudate was measured for all patients. The level of endogenous intoxication was assessed based on the volume (degree) of medium-molecular peptides (MMP) using spectrometry with a wavelength of 210 nm.

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RESULTS AND DISCUSSION

Considering the presence of diabetes mellitus comorbidity among this cohort of patients with purulent surgical soft tissue diseases, all individuals underwent medication adjustments to regulate blood sugar levels, overseen by an endocrinologist. The majority of patients, 77 (89.5%), were diagnosed with type II diabetes, while 9 (10.5%) patients had type I diabetes.

Upon admission, the initial blood sugar levels for patients in Group II averaged 12.8±1.1 mmol/L. Following comprehensive treatment, including specific therapy for diabetes in collaboration with the endocrinologist, the blood sugar levels decreased to an average of 7.8±0.8 mmol/L by the 5th or 6th day of treatment. Insulin therapy was personalized based on individual patient characteristics.

As illustrated in the table, on the first day of treatment, patients exhibited an average body temperature of 38.6±0.36°C. The white blood cell count in the blood averaged 9.2±0.38 x 10^9/L, and the concentration of medium-molecular peptides averaged 0.194±0.008 units. Similar increases were observed in the leukocytic index of intoxication (LII) and erythrocyte sedimentation rate (ESR).

Table 1

Dynamics of intoxication parameters in patients with purulent surgical diseases of soft tissues, Group I (n=86)

Indicators	Observation time:				
	Day of admission	Day 3	Day 5	Day 7	Day 9-10
t^0 - body temperature	38,6±0,36	38,1±0,14*	37,8±0,17*	37,1±0,16	36,8±0,11*
L – white blood cell count $\times 10^9$/L	9,2±0,38	8,4±0,32*	7,6±0,26	7,2±0,22	6,8±0,28
MMP – Medium-molecular peptides (units)	0,194±0,008	0,158±0,006**	0,144±0,005	0,134±0,005**	0,118±0,004***
LII – Leukocytic index of intoxication (units)	2,1±0,08	1,8±0,08*	1,6±0,06	1,5±0,04	1,2±0,05***

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ESR – Erythrocyte sedimentation rate (mm/h)	43,1±1,76	38,2±1,46*	36,5±1,44*	29,8±1,12***	21,1±0,65* **

Note: * - significant differences compared to the previous day's data (* - P<0.05, ** - P<0.01, *** - P<0.001)

On the third day of treatment, a slight reduction in body temperature was noted, with an average of 38.1±0.14°C, alongside a decrease in the white blood cell count to an average of 8.4±0.32×10^9/L. The concentration of medium-molecular peptides (MMP) averaged 0.158±0.006 units. Furthermore, reductions were observed in the leukocytic index of intoxication (LII) and erythrocyte sedimentation rate (ESR), reaching 1.8±0.08 and 38.2±1.46, respectively.

By the fifth day of treatment, patients in the comparative group with purulent soft tissue diseases still exhibited a mild subfebrile state (37.8±0.17°C). All markers of systemic intoxication - L, MMP, LII, and ESR - continued to decrease, indicating a trend towards normalization, with values of 7.6±0.26×10^9/L, 0.144±0.005 units, 1.6±0.06, and 36.5±1.44, respectively. Despite this downward trend, these values remained elevated above normal levels by the seventh day of treatment.

Through continued treatment and observation until the tenth day, all assessed markers of intoxication, except for ESR, fell within the normal range.

Upon admission, patients in the analyzed group exhibited a significantly lower initial pH level in the wound environment (indicative of acidosis), averaging 4.1±0.16. The protein content in wound exudate averaged 58.4±1.57g/L. The prognostic coefficient (PC) in this instance averaged 0.9±0.01 units.

Table 2

Dynamics of biochemical parameters and wound healing rate in patients of Group I (n=86)

Indicators	Observation time:				
	Day 1	Day 3	Day 5	Day 7	Day 9-10
pH of the wound environment	4,1±0,16	4,4±0,12	,9±0,13***	5,8±0,19	6,9±0,26***
Percentage reduction of wound surface area	0	0,6±0,03***	,1±0,08***	2,2±0,11***	2,9±0,16

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Wound exudate protein (g/L)	58,4±1,57	55,4±1,34	7,2±1,18***	42,9±1,19	-
Total blood protein (g/L)	61,8±2,41	65,1±1,82	6,8±1,72	69,8±1,66	70,1±2,21
Prognostic coefficient (PC) according to M.F. Mazurik	0,9±0,01	1,2±0,03**	,4±0,04***	1,5±0,02*	-

Note: * - significant differences compared to the previous day's data (* - P<0.05, ** - P<0.01, *** - P<0.001)

By the third day of treatment, the pH of the wound environment averaged 4.4±0.12, and there was an average daily reduction in wound surface area of 0.6±0.03%. The protein content in the wound exudate averaged 55.4±1.34g/L, while in the blood, it was 65.1±1.82g/L. The Prognostic coefficient (PC) according to Mazurik was 1.2±0.03. By the fifth day of treatment, there was a tendency towards neutralization in the pH of the wound environment, reaching a value of 4.9±0.13. The percentage reduction in wound surface area increased to 1.1±0.08% per day, and the PC at this juncture was 1.4±0.04.

By the seventh day, the PC had risen to 1.5±0.02, and the reduction in wound surface area had significantly increased to 2.2±0.11% per day. The pH of the wound environment at this stage averaged 5.8±0.19. Only by the tenth day of treatment did the pH of the wound environment achieve neutrality. The daily reduction in wound surface area reached 2.9±0.16%. Exudate secretion from the wound ceased, which we attribute to the transition of the wound process from the first to the second phase.

Analysis of the level of microbial contamination in purulent wounds among patients in this group revealed the following: upon admission, the average microbial contamination was 108 cfu/g, decreasing to 105 cfu/g in the subsequent days following surgical wound treatment with ointment dressings. By the 7th-8th day of comprehensive treatment, the degree of microbial contamination in these patients fell below the critical level to 102 cfu/g of tissue.

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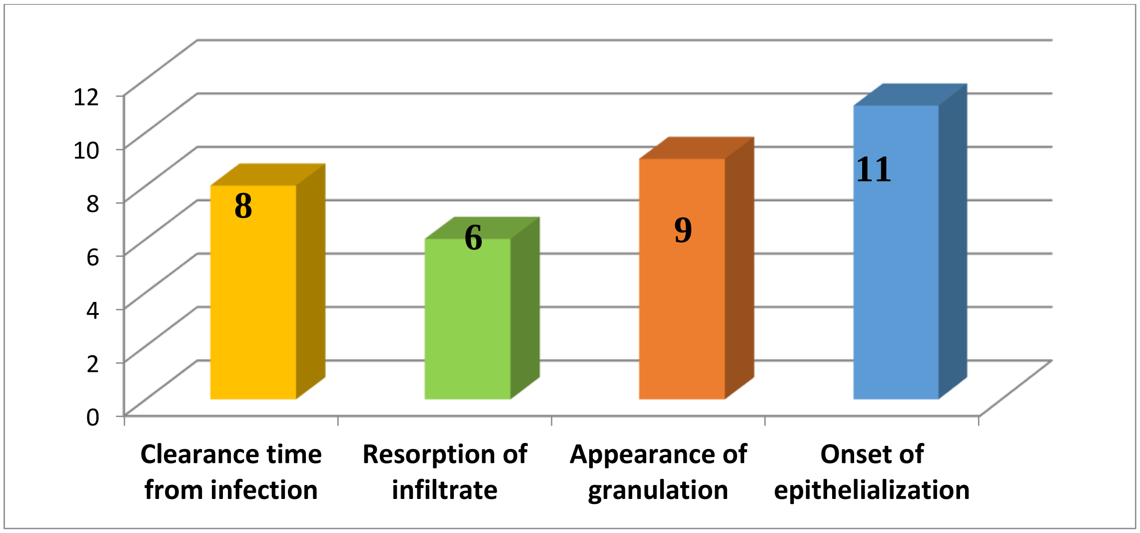

Figure 2: Clearance and healing time of wounds in patients of the comparative group with purulent-necrotic diseases (n=86)

The findings from the assessment of wound clearance and healing duration in patients of Group II, as depicted in Figure 5, suggest that in this cohort, the average time for clearing the wound from infection was 8.0±0.5 days. By the sixth day, a noticeable reduction in infiltration was observed, with the onset of granulation tissue noted typically on the seventh to eighth days.

Our investigation into patients with purulent-necrotic soft tissue diseases unveiled distinct aspects of the wound healing process under conventional treatment alongside concurrent diabetes. Upon admission, the average blood sugar level stood at 12.8±1.1, with the transition to the third phase of wound healing typically occurring on the 7th to 8th day of treatment. These parameters exhibited a discernible correlation throughout the treatment course, demonstrating favorable trends.

In this subgroup of patients with purulent-necrotic soft tissue diseases, the surgical intervention approach on admission mirrored that of the preceding group. The majority of diabetic patients had type II diabetes (19 patients, 90.4%), while 2 patients (9.6%) had type I diabetes.

Analysis of indicators reflecting systemic intoxication in patients with purulent-necrotic soft tissue diseases of Group II revealed notable changes (Table 3). Notably, on the first day of treatment, patients exhibited an average body temperature of 38.9±0.41°C. The leukocyte count in the blood averaged 9.6±0.22x109/L, with the concentration of middle molecules averaging 0.244±0.011 units. Similarly, increases in leukocytic index of intoxication (LII) and erythrocyte sedimentation rate (ESR) were observed.

Table 3

Dynamics of indicators of intoxication in patients with purulent-necrotic soft tissue diseases of Group II (n=21)

Indicators	Observation time:				
	Day of admission	Day 3	Day 5	Day 7	Day 9-10
t^0 - body temperature	38,9±0,41	38,7±0,21*	38,0±0,18*	37,7±0,16	36,9±0,12*
L – white blood cell count ×10^9/L	9,6±0,22	8,9±0,28*	8,4±0,32	7,9±0,18	6,9±0,17
MMP – Medium-molecular peptides (units)	0,244±0,011	0,211±0,017**	0,192±0,005	0,178±0,015**	,128±0,006***
LII – Leukocytic index of intoxication (units)	2,3±0,07	2,1±0,09*	1,9±0,07	1,7±0,04	1,4±0,06***
ESR – Erythrocyte sedimentation rate (mm/h)	48,1±1,88	42,3±1,54*	39,5±1,22*	32,7±1,18***	24,1±0,56***

Note: * - significant differences compared to the previous day (* - P<0.05, ** - P<0.01, *** - P<0.001)

On the third day of treatment, a minor reduction in body temperature was observed, decreasing from 38.9±0.41 to 38.7±0.21°C, while the white blood cell count decreased to an average of 8.9±0.28×109/L. The concentration of middle molecules was measured at 0.211±0.017 units. Additionally, indicators of leukocytic index of intoxication (LIИ) and erythrocyte sedimentation rate (ESR) decreased to 2.1±0.09 and 42.3±1.54, respectively.

By the fifth day of treatment, patients in the comparative group with purulent soft tissue diseases still exhibited a slight subfebrile state (38.0±0.18°C). However, all markers of systemic intoxication, including leukocytes (L), middle molecules (MSM), LIИ,

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and ESR in the blood, continued to decline, signifying a trend towards normalization: 8.4±0.32×109/L; 0.192±0.005 units; 1.9±0.07; 39.5±1.22, respectively. Nevertheless, by the seventh day of treatment, although these values persisted in their downward trajectory, they remained elevated above the normal range.

Upon further treatment and observation until the tenth day, all analyzed markers of intoxication, except for middle molecules and ESR in the blood, fell within the normal range.

The assessment of wound process dynamics in patients relied on several criteria: pH of the wound environment, percentage reduction in wound surface area, and the Prognostic Coefficient (PK) according to M.F. Mazurik (Table 4). For patients in the studied group, the initial pH level of the wound environment upon admission was notably lower (indicating acidosis), averaging 4.2±0.14. The protein content in wound exudate averaged 57.9±1.33 g/L, with the PK value measured at 0.9±0.02 units.

Table 4

Dynamics of biochemical indicators and wound healing rate in patients of Group II (n=21)

Indicators	Observation time:				
	Day 1	Day 3	Day 5	Day 7	Day 9-10
pH of the wound environment	4,2±0,14	4,3±0,16	4,7±0,14***	5,7±0,21	6,7±0,28***
Percentage reduction of wound surface area	0	0	0,6±0,03***	1,1±0,08***	2,2±0,11***
Wound exudate protein (g/L)	57,9±1,33	54,3±1,38	45,2±1,16***	43,6±1,19	40,4±1,26
Total blood protein (g/L)	59,6±1,44	59,8±1,32	60,7±1,72	61,9±2,64	63,1±2,17
Prognostic coefficient (PC) according to M.F. Mazurik	0,9±0,02	1,1±0,04**	1,3±0,03***	1,4±0,04*	1,5±0,04*

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Note: * - differences relative to the previous day are significant (* - P<0.05, ** - P<0.01, *** - P<0.001)

By the third day of treatment, the pH of the wound environment averaged 4.3±0.16, with no discernible reduction in wound surface area noted. The protein content in wound exudate averaged 54.3±1.38 g/l, while in the blood, it was 59.8±1.32 g/l. The Prognostic Coefficient (PK) according to Mazurik stood at 1.1±0.04. By the fifth day of treatment, there was a trend towards neutralization in the pH of the wound environment, reaching a value of 4.7±0.14. The percentage reduction in wound surface area increased to 0.6±0.03% per day, with the PK at this juncture measured at 1.3±0.03.

By the seventh day, the PK had risen to 1.4±0.04, and the wound surface area exhibited a significant reduction of 1.1±0.08% per day. The pH of the wound environment at this time averaged 5.7±0.21. Only by the tenth day of treatment did the pH of the wound environment achieve neutrality. The daily reduction in wound surface area reached 2.2±0.11%. Moreover, the secretion of exudate from the wound ceased, which, in our assessment, is indicative of the transition of the wound process from the first to the second phase.

Analysis of the level of microbial contamination in the purulent wounds of Group II patients revealed the following: upon admission, microbial contamination averaged 108 cfu/g (colony-forming units per gram). In the subsequent days following surgical wound treatment with ointment dressings, this value decreased to 105 cfu/g. By the 9th day of comprehensive treatment, the degree of microbial contamination in these patients fell below the critical level, amounting to 102 cfu/g of tissue.

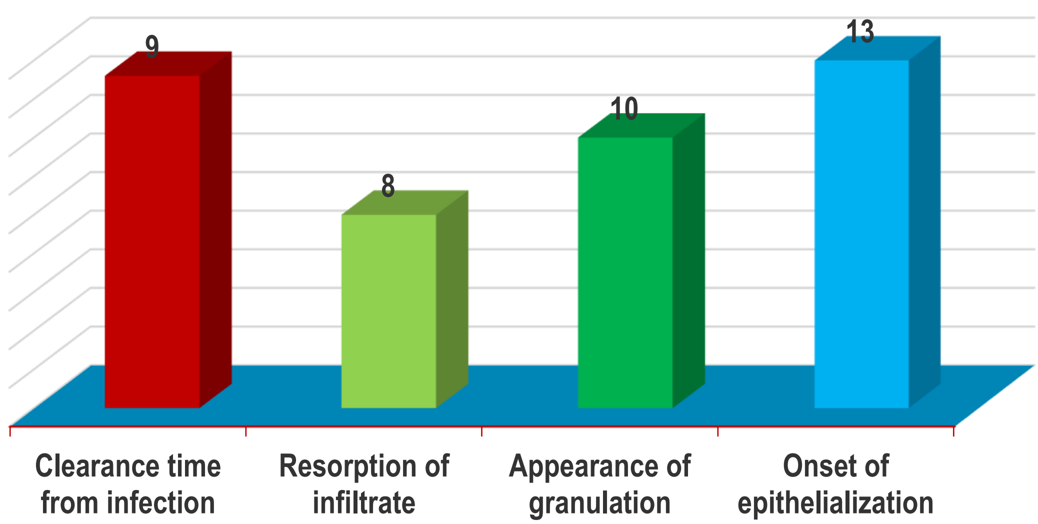

Figure 3: Time of Cleansing and Wound Healing in Group II Patients with Purulent-Necrotic Diseases (n=21)

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The analysis results concerning the time required for wound cleansing and healing in patients of Group II are depicted in Figure 3, indicating an average duration of 9.0±0.5 days for cleansing the wound from infection. By the eighth day, resorption of infiltrate was observed, while the onset of granulation typically occurred around the ninth to tenth day. It wasn't until the thirteenth day that predominantly regenerative-type cytograms were observed, a finding corroborated by cytological examinations.

Upon admission, Group II patients exhibited an average blood sugar level of 13.8±1.2. Throughout the treatment of purulent soft tissue surgical diseases, along with concurrent medication adjustments for blood sugar levels, these parameters gradually normalized.

The investigation into thyroid gland hormone levels among Group II patients with purulent soft tissue diseases, alongside diabetes and diffuse toxic goiter, unveiled notable deviations from the norm upon admission. Specifically, there was a decrease in TSH activity, accompanied by a sharp increase in thyroid hormones T-3 and T-4 (as detailed in Table No. 5). These disruptions significantly exacerbated the wound healing process, resulting in delayed wound cleansing and a transition of the wound process from the first to the second phase.

Table 5

Dynamics of Thyroid Hormone Levels in Group II Patients (n=21)

Indicators	Observation time:				
	In normal range	Day of admission	Day 3	Day 5	Day 7
T3 (Triiodothyronine) in nmol/L	1,5-3,8	4,1±0,17	3,95±0,15	3,88±0,11	3,54±0,11
T4 (Thyroxine) in nmol/L	90-120	138±3,45	127±4,17	121±2,15	112±4,18
TSH (Thyroid-Stimulating Hormone) in µIU/mL	0,10-4,0	0,085±0,012	0,09±0,019	0,11±0,014	1,9±0,021

CONCLUSION

Therefore, our investigation into Group II patients with purulent-necrotic soft tissue diseases, in the context of

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coexisting diabetes and diffuse toxic goiter, unveiled distinct characteristics of the wound healing process. Upon admission, these patients exhibited significant deviations from the norm in terms of body intoxication indicators and wound environment pH compared to Group I patients. While traditional treatment methods led to a gradual normalization of these indicators, the process occurred at a slower pace compared to Group I, trailing by approximately 2 days. The average duration of hospitalization for Group II patients was 10±1.4 days, whereas for Group I patients, it was 8±1.5 days.

The correlation identified through our study, between the presence of concurrent pathologies and the adverse disease course, underscores the imperative of promptly addressing hormonal, carbohydrate, and protein metabolism disorders in the management of purulent surgical soft tissue diseases amidst diabetes, diffuse toxic goiter, and their combined manifestation.

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