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Clinical Laboratory Tests in Some Acute Exogenous Poisonings

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Background: There is no specific toxicological screening of clinical laboratory parameters in clinical toxicology when it comes to acute exogenous poisoning.

Aim: To determine routine clinical laboratory parameters and indicators for assessment of vital functions in patients with acute intoxications.

Materials and methods: One hundred and fifty-three patients were included in the present study. They were hospitalized in the Department of Clinical Toxicology at St. George University Hospital, Plovdiv for cerebral toxicity inducing medication (n = 45), alcohol (n = 40), heroin abuse (n = 33). The controls were 35. The laboratory tests were conducted in compliance with the standards of the clinical laboratory. We used the following statistical analyses: analysis of variance (the u-criterion of normal distribution, the Student's t-test, dispersion analysis based on ANOVA) and non-parametric analysis.

Results and discussion: Based on the routine hematological parameters with statistically significant changes in three groups of poisoning are: red blood cells, hematocrit, hemoglobin (except alcohol intoxication) and leukocytes. We found statistically significant changes in serum total protein, sodium and bilirubin. The highest statistical significance is the increased activity of AST and ALT.

Conclusion: We present a model for selection of clinical laboratory tests for severe acute poisoning with modern equipment under standardized conditions. The results of the study suggest that the clinical laboratory constellation we used can be used as a mandatory element in the diagnosis of moderate and severe intoxication with the mentioned toxic substances.

BACKGROUND

Acute poisonings are a serious diagnostic and therapeutic problem in modern medicine. They are life-threatening emergencies and should be immediately treated using regimens based on accurate assessment of the severity of the poisoning. This can be done based on the clinical examination overt symptoms, toxic chemical analysis and clinical laboratory tests.

Urgent laboratory tests and accurate laboratory data contribute substantially to achieving the main aim of the ICU: quick and accurate diagnosis, speeding up medical and intensive care, reduce the mortality and stay in the ICU.[1] The question of laboratory profile emergencies has two main sides: selection of appropriate indicators and determination of critical limits - the low and high extreme values of laboratory parameters in which the patient's life is in danger.[2,3]

AIM

To determine the routine laboratory parameters and indicators for assessing the vital functions in patients with acute exogenous poisoning.

MATERIALS AND METHODS

The present study included 153 patients with acute exogenous poisoning. They were hospitalized in the Department of Clinical Toxicology at St. George University Hospital, Plovdiv for about 2 years. All patients were divided into groups as shown in **Table 1**.

All clinical and laboratory investigations were carried out in the Central Clinical Laboratory of St George University Hospital, Plovdiv. The laboratory participates in national and international systems of external quality assessment and has relevant certificates.

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Table 1. Study groups

Acute poisoning with cerebral depression-inducing medications	Acute poisoning with alcohol	Acute poisoning with heroin	Control group of healthy subjects	Total
n = 45	n = 40	n = 33	n = 35	153

Statistical analysis was performed using the statistical package SPSS ver. 11 and MS Excel.

RESULTS AND DISCUSSION

Routine hematology

Erythrocytes: The data in the three groups of acute poisoning were significantly increased in comparison with the controls. The differences were statistically significant, confirming the alternative hypothesis (F = 8.3, P <0.001). The within group comparison confirms the above conclusion. We could not find any differences in the number of red blood cells between the groups of patients **(Table 2)**.

Hemoglobin: The data reported lower values of the indicator in all three groups of toxic substances - heroin, alcohol and drugs compared to the control group. The difference is confirmed by calculations for F-criteria (F = 5.03, P <0.01). Conducted intergroup comparison criterion for normal distribution shows that hemoglobin values were statistically significantly lower than those of the control group in acute poisoning with heroin and drugs - Ru <0.001. Absent marked difference in alcohol intoxications **(Table 2)**.

Hematocrit: Hematocrit values in the three groups were lower than the arithmetic mean of the control group. The differences are statistically significant at Ur 99.99%. Averages in all three patient groups did not differ **(Table 2)**.

Table 2. Basic parameters of routine hematological parameters in the control and study groups

Parameter	Groups	n	0±S0	Sx	F	P	u	Pu
Erythrocytes ($1x10^{12}$/l)	heroin	33	9.73 ± 1.01	5.79	8.13	<0.001	3.31*	<0.001
	alcohol	40	10.19 ± 0.51	3.23			7.38**	<0.001
	medicaments	45	9.11 ± 0.47	3.18			18.40***	<0.001
	controls	35	6.35 ± 0.14	0.86				
Hemoglobin (g/l)	heroin	33	133.42±2.53	14.52	5.03	<0.01	3.70*	<0.001
	alcohol	40	140.72±3.17	20.08			1.21**	>0.05
	medicaments	45	133.53±2.21	14.84			3.72***	<0.001
	controls	35	145.23±1.95	11.54				
Hematocrit (l/l)	heroin	33	0.41 ± 0.01	0.05	12.90	<0.001	4.29*	<0.001
	alcohol	40	0.42 ± 0.01	0.08			3.57**	<0.001
	medicaments	45	0.39 ± 0.01	0.04			5.72***	<0.001
	controls	35	0.47 ± 0.01	0.05				
Leukocytes ($1x10^{9}$/l)	heroin	33	9.73 ± 1.01	5.79	8.13	<0.001	3.31*	<0.001
	alcohol	40	10.20 ± 0.51	3.23			7.26**	<0.001
	medicaments	45	9.11 ± 0.47	3.18			5.21***	<0.001
	controls	35	6.35 ± 0.14	0.86				
Platelet ($1x10^{9}$/l)	heroin	33	256.15±14.02	80.54	1.40	>0.05	-	-
	alcohol	40	264.12±12.73	80.52				
	medicaments	45	255.35±9.17	61.51				
	controls	35	283.66±6.03	35.65				

* - comparison controls/drug
** - comparison controls/alcohol
*** - comparison controls/medicament.

Table 3. Average clinical laboratory indicators of homeostasis in control and study groups

Parameter	Groups	n	0±S0	Sx	F	P	u	Pu
Serum total protein (g/l)	heroin	33	65.42 ± 1.39	7.97	6.16	<0.01	4.74*	<0.001
	alcohol	40	67.78 ± 1.06	6.72			3.96**	<0.001
	medicaments	45	68.02 ± 1.25	8.40			3.29***	<0.001
	controls	35	72.49 ± 0.55	3.24				
Urea (mmol/l)	heroin	33	6.37 ± 1.00	5.78	1.27	>0.05	-	-
	alcohol	40	5.50 ± 0.30	1.92				
	medicaments	45	4.63 ± 0.47	3.12				
	controls	35	6.47 ± 1.23	7.28				
Creatinine (mmol/l)	heroin	33	95.30 ± 5.37	30.88	0.53	>0.05	-	-
	alcohol	40	93.75 ± 4.78	30.17				
	medicaments	45	89.15 ± 4.75	31.88				
	controls	35	96.48 ± 2.76	16.32				
Sodium (Na) (mmol/l)	heroin	33	145.06 ± 0.74	4.28	17.03	<0.001	4.27*	<0.001
	alcohol	40	143.58 ± 0.97	6.14			4.76**	<0.001
	medicaments	45	141.36 ± 0.76	5.13			7.92***	<0.001
	controls	35	149.20 ± 0.63	3.71				
Potassium (K) (mmol/l)	heroin	33	4.02 ± 0.10	0.56	1.67	>0.05	-	-
	alcohol	40	3.90 ± 0.11	0.71				
	medicaments	45	3.99 ± 0.07	0.49				
	controls	35	4.18 ± 0.05	0.29				
Chlorine (Cl) (mmol/l)	heroin	33	99.72 ± 0.45	2.62	0.75	>0.05	-	-
	alcohol	40	100.23 ± 0.66	4.20				
	medicaments	45	100.16 ± 0.50	3.36				
	controls	35	100.89 ± 0.38	2.27				
Glucose (mmol/l)	heroin	33	6.52 ± 0.61	3.45	0.97	>0.05	-	-
	alcohol	40	8.55 ± 0.82	5.18				
	medicaments	45	6.54 ± 0.41	2.73				
	controls	35	7.15 ± 1.78	10.47				
AST (U/l)	heroin	33	78.64 ± 21.64	124.31	3.86	<0.05	-	-
	alcohol	40	48.40 ± 8.37	52.95				
	medicaments	45	37.93 ± 10.67	71.59				
	controls	35	18.51 ± 1.43	8.47				
ALT (U/l)	heroin	33	77.76 ± 19.64	112.81	5.01	<0.05	-	-
	alcohol	40	46.30 ± 9.18	58.67				
	medicaments	45	34.13 ± 9.43	63.25				
	controls	35	14.43 ± 1.26	7.48				
Bilirubin (mmol/l)	heroin	33	13.10 ± 1.17	6.72	5.18	<0.01	0.10*	>0.05
	alcohol	40	15.76 ± 1.06	6.71			2.29**	>0.05
	medicaments	45	11.35 ± 0.71	3.34			1.74***	>0.05
	controls	35	12.97 ± 0.60	3.57				

* - comparison controls/drug
** - comparison controls/alcohol
*** - comparison controls/medicaments

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Leukocytes: The number of leukocytes in the three groups exceeds a statistically significant number of the control group. The conclusion is confirmed by the data from ANOVA, and the intergroup comparison carried out with u-criterion of normal distribution. It should be noted that there are no significant differences between patient groups **(Table 2)**.

Platelets: The analysis confirms the null hypothesis, i.e. there are no differences between the control group and three groups of acute intoxications, and between the acute poisoning with heroin, alcohol and medications **(Table 2)**.

Clinical laboratory parameters for evaluation of vital functions

2.1. Clinical chemistry parameters

Serum total protein: The average values of the serum total protein in the three groups of acute poisoning are lower than those in the control group. The conclusion is confirmed by both the value of the F-criterion, and the held within group comparison of the control with each of the groups of acute intoxications. The comparison between the three study groups does not show significant differences **(Table 3)**.

Sodium: sodium values in the three groups of acute are lower than those in the control group. The conclusion is confirmed by both the F-criterion. and the criterion of u-normal distribution used in the comparison of the control with the other groups **(Table 3)**. Significant difference is registered in the comparison between heroin and medicaments ($u = 3.49$, $P < 0.001$).

Urea, Creatinine, Glucose, Potassium, and Chlorine - no registered statistical differences between the average values of the experimental groups and the control **(Table 3)**.

AST: There is a strongly expressed difference between the average of the control group and the average of the other three groups. The alternative hypothesis is determined by the highest values of the indicator - two times higher in patients with acute poisoning with medication, over two and a half times to those with poisoning by alcohol and four and a half times higher value in poisoning with heroin **(Table 3)**.

Due to the very high variability in both ACAT enzyme and ALT (values standard deviation higher than the arithmetic mean) a method of percentile was used, which confirms the authenticity of the found higher levels of performance **(Table 4)**.

Bilirubin: Significant differences are found in this indicator upon comparison of a group of patients with alcoholic poisoning with these with medicaments and the control group. The difference is determined by significantly higher average value of the index in alcoholic poisoning **(Table 3)**.

It should be noted that the resulting changes in the values of monitored clinical laboratory parameters were compared with the control group, but within the reference intervals. Exceptions are the enzymes AST and ALT, whose increase is significantly above the normal range.

The resulting changes in the values of monitored routine haematological parameters and indicators for assessing the vital functions that do not relate to the very specific in terms of acute poisoning associated with the severity of acute intoxication.

We believe that the significantly increased activity of the enzymes AST and ALT and total bilirubin are related to hepatic metabolism and direct link to those three toxic phenoxy - heroin, alcohol and cerebrotoxical medicaments, whose main exchange takes place in the liver. Proof of this is the fact that almost four was elevated AST and ALT in

Table 4. Normal distribution of AST and ALT (in percentiles)

Parameters	AST	ALT
Number	153	153
0 ± S0	45.0065±6.20855	42.2157±5.82457
Sx	76.79548	72.04594
Minimum value	3.00	6.00
Maximum value	698.00	625.00
Percentiles		
10	11.4000	9.0000
20	14.0000	11.0000
25	16.0000	13.0000
30	19.0000	15.2000
40	21.0000	17.6000
50	26.0000	23.0000
60	32.0000	28.0000
70	42.6000	39.0000
75	46.0000	43.0000
80	49.0000	48.2000
90	69.0000	73.0000

heroin intoxication and more than two and a half times in poisoning with alcohol, and bilirubin in acute alcoholic intoxication.

2.2. Other indicators related to intoxication. Blood-gas analysis

Blood-gas analysis was performed in 105 patients. In 38 of them (36.19%) it revealed no deviations from the reference intervals. In 28 patients there was a compensated metabolic acidosis and, if uncompensated 39, i.e., in 63.81% of patients studied with acute poisoning is established metabolic acidosis in varying degrees.

The distribution of changes in blood-gas analysis according to the type of toxic knox is shown in **Fig. 1**.

The prevalence of uncompensated metabolic acidosis in heroin poisoning is logical, given that it is dominated by the severe degree of intoxication (60.61%).

Compensated metabolic acidosis occurs in the highest percentage in acute alcoholic intoxication in which the leading role is moderate intoxication (62.50%).

Our results are confirmed by observations of other authors who have not established characteristic changes in the cited studies. We must emphasize, however, that they were carried out considerably more remote period.[4-14] Our tests, carried out with modern equipment under standardized conditions, confirms the current trend observed in the recent years.[15-21]

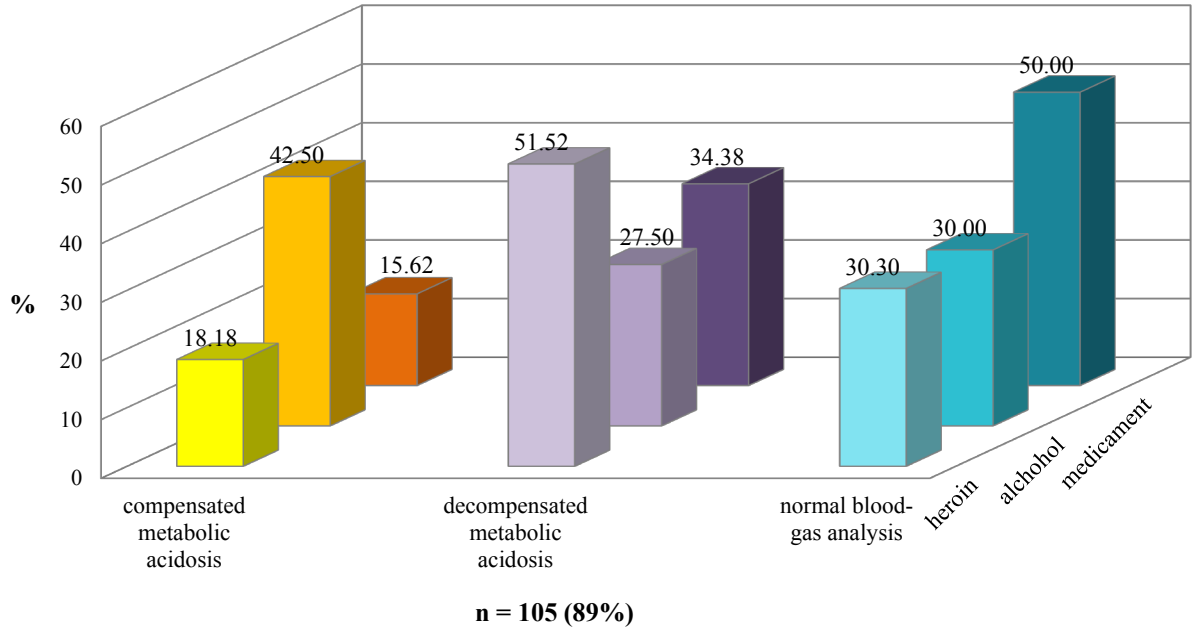

Figure 1. Distribution of changes in blood gas analysis according to the type of toxic substance.

CONCLUSIONS

The examined clinical laboratory parameters allow us to draw the following important conclusions:

From routine hematological parameters with statistically significant changes in the three groups acute exogenous poisoning (cerebro-depressive medicaments, alcohol and heroin) are: red blood cells, hematocrit, hemoglobin (except intoxication with alcohol) and leukocytes.

From a clinical-chemical indicators to assess the vital functions statistically significant change was recorded in total protein, sodium and bilirubin.

The highest statistical significance is the increased activity of AST and ALT.

The analyzed blood gas analysis in 63.81% of patients established metabolic acidosis in varying degrees.

CONCLUSION

In clinical toxicology no specific toxicological screening of clinical laboratory parameters at AEP exist.

Although the laboratory tests included in the study do not apply to very specific in terms of acute poisoning. The statistically significant changes in their levels allow us to offer as required under intoxica-

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tion cerebro-depressive drugs, alcohol and heroin.

Although nonspecific studied indicators would help clinicians, toxicologists in building a comprehensive objective assessment of severity, the pace of development and degree of damage organs in acute intoxications. Study and monitoring of the levels of these laboratory values is also important to assess the possibilities of compensating harmed by toxic phenoxy body.

Taking into consideration the above presented model for the selection of clinical laboratory tests with modern equipment under standardized conditions of work, which could serve as diagnostic markers for the complex assessment of the laboratory profile for acute exogenous poisoning.

REFERENCES

1. Orbetsova V. Selection and evaluation of the clinical laboratory analysis in terms of urgency. In: Tsvetkova T, editor. Clinical laboratory results. Part II. Plovdiv: Higher Medical Institute; 1997:503-6 (Bulgarian).
2. Ellenhorn JM. Ellenhorn's Medical Toxicology. 2nd ed. New York: Williams/Wilkins; 1997.
3. Goldfrank L, Flomenbaum NE, Lewin NA, et al, editors. Goldfrank's Toxicologic Emergencies. 4th ed. Norwalk, Connecticut: Appleton/Lange; 1990.
4. Finkle BS. Forensic toxicology of drugs: a toxicology status report. Anal Chem 1972;44:19A.
5. Done AK. The toxic emergency: asking for laboratory backup. Emerg Med 1977;9(2):91.
6. Bailey DN, Guba JJ. Survey of emergency toxicology screening in a university medical center. J Anal Toxicol 1979;3:133.
7. Mowrey JB, Skoutakis VA. Use of the toxicology laboratory in the management of intoxicated patients. Clin Toxicol Consult 1981;1:71.
8. Helper BR, Sutheimer CA, Sunshine I. The role of the toxicology laboratory in emergency medicine. J Toxicol Ilin Toxicol 1982;19:353-65.
9. McCarron MM. The role of the toxicology laboratory in the treatment of the poisoned patients: clinical perspective. J Anal Toxicol 1983;7:142.
10. Weisman RS, Howand MA. The toxicology laboratory. In: Goldfrank LR, editor. Goldfrank's Toxicologic Emergencies. 3rd ed. East Norwalk, Connecticut: Appleton-Century-Crofts; 1986.
11. Snyder JW, Vlasses PH. The role of the laboratory in treatment of the poisoned patient. Arch Intern Med 1988;148:279-80
12. Leonard KA, Bock JL. Toxicology screening: role of the clinical laboratory. In: Viccellio P, editor. Handbook of Medical Toxicol. Boston: Little and Brown; 1993:118-25.
13. Taboulet P, Azoyan P. Place des examens complémentaires dans la démarche thérapeutique de l'urgence toxicologique. Med Urg 1994;10(1):12-7.
14. Wu YL. Laboratory medicine practice guidelines. Clin Chem 2003;49(30):357-79.
15. Shin JM, Sachs G, Kraut JA. Simple diagnostic tests to detect toxic alcohol intoxications. Transl Res 2008;152(4):194-201.
16. Rentsch KM. Laboratory diagnostics in acute poisoning: critical overview. Clin Chem Lab Med 2010;48(10):1381-7.
17. Montoya ID, McCann DJ. Drug of abuse: management of intoxication and antidotes. EXS 2010;100:519-41.
18. Gomółka E, Kapala M, Hydzik P. Confirmed poisonings with ethylene glycol and methanol in south Poland in the years 2010-2012 based on results from toxicological laboratories in Kraków and Sosnowiec. Przegl Lek 2013;70(8):506-10.
19. Kraut JA. Diagnosis of toxic alcohols: limitations of present methods. Clin Toxicol (Phila) 2015;53(7):589-95.
20. Roberts DM, Yates C, Megarbane B, et al. EXTRIP Work Group. Recommendations for the role of extracorporeal treatments in the management of acute methanol poisoning: a systematic review and consensus statement. Crit Care Med 2015;43:461-72.
21. Pajoumand A, Zamani N, Hassanian-Moghaddam H, et al. Can duration of hemodialysis be estimated based on the on-arrival laboratory tests and clinical manifestations in methanol-poisoned patients? Int Urol Nephrol 2017;49(6):1057-62.

Клинические лабораторные исследования при некоторых острых экзогенных отравлениях

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Введение: Не существует специфического токсикологического скрининга клинических лабораторных параметров в клинической токсикологии, что касается острого экзогенного отравления.

Цель: Целью настоящего исследования является отслеживание клинических рутинных лабораторных параметров и индикаторов оценки жизненно важных функций при группах острых отравлений.

Материалы и методы: Общее количество пациентов, принявших участие в исследовании, составило 153 человека. Среди них были госпитализированные в кафедре клинической токсикологии при Университетской больнице „Св. Георгий" в Пловдиве вследствие приёма медикаментов церебротоксического действия (n = 45), алкоголя (n = 40), героина (n = 33) и "контрольная группа" (n = 35). Клинические лабораторные исследования были проведены в соответствии с установленными стандартами клинической лаборатории. В исследовании применялись следующие методы статистического анализа: дисперсионный анализ/ U-критерий нормального распределения, T-тест Стьюдента, дисперсионный анализ, основанный на тестовом методе ANOVA и непараметрический анализ.

Результаты и обсуждение: Основными рутинными гематологическими параметрами со статистически значимыми изменениями в трёх группах отравлений являются: эритроциты, гематокрит, гемоглобин (за исключением случаев отравления алкоголем) и левкоциты. Клинико-химические показатели оценки жизненных функций со статистически значимой разницей были установлены при сывороточном общем белке, натрии и билирубине. Наиболее высокие показатели статистически значимой разницы установлены при повышенной активности АСАТ и АЛАТ.

Заключение: Нами представлена модель селекции клинических лабораторных исследований острого отравления тяжёлой степени с применением современного оборудования в стандартизированных условиях. Установленные изменения показывают, что использованная совокупность клинико-лабораторных методов исследования применима в качестве обязательного элемента при диагнозе интоксикации умеренной и тяжёлой степени перечисленными токсическими веществами.