https://doi.org/10.48047/AFJBS.6.7.2024.4079-4090

African Journal of Biological Sciences

Research Paper Open Access

Factors affecting the clinical outcome of dialysis patients with cardiorespiratory arrest - cohort a retrospective study

Shahrouz Tabrizi[1,2], Akram Zolfaghari sadrabad[1,2],Farshid Mirzaea, Mohammad Reza Farnia[1,2],Barreza Rezaei[1,2]

[1]Department of Emergency Medicine, Faculty of Medicine, Kermanshah University of Medical Science, Kermanshah, Iran

[2]Clinical Research Development Center, Imam Ali and Taleghani Hospital, Kermanshah University of Medical Science, Kermanshah, Iran

Article History
Volume 6, Issue 7, 2024
Received: 09 March 2024
Accepted: 19 April 2024
doi:
10.48047/AFJBS.6.7.2024.4079-4090

Abstract

Patients with chronic kidney disease and ESRD are known as one of the high-risk groups for sudden cardiac death. Therefore, this study was conducted in order to determine the clinical outcomes of cardiopulmonary resuscitation in ESRD and dialysis patients and the factors affecting it in an academic tertiary hospital in west of Iran. In this retrospective cross-sectional study, ESRD patients hospitalized or referred to the emergency department of our center who underwent cardiopulmonary resuscitation from 2021 to 2022 were included. Demographic and clinical information was collected and recorded from patient data file. The collected data were analyzed using SPSS v25. Of 112 patients included 72 cases (64.3%) were men and 40 cases (35.7%) were women. The mean and standard deviation of the age of the subjects was 66.86 ± 18.08 years. The average and standard deviation of the age of people by gender were 66.99±18.79 and 66.63±16.93 in men and women, respectively. 42 resuscitation cases (36.5%) were successful. Demographic factors (gender, age, education level, place of residence, height, weight and BMI), as well as initial heart rhythm and underlying diseases (hypertension, hyperlipidemia, previous history of CVA, myocardial infarction, cancer, drug poisoning, duration of dialysis), the witnessed arrest and the ward where resuscitation was done, had no significant relationship with the clinical outcome. Only the duration of resuscitation had a significant relationship with outcome and the success rate of resuscitation was less in prolonged resuscitation. Dialysis patients are usually complicated and suffer from multiplecomorbidities. In this study, no underlying factor with a significant relationship with the clinical outcome of cardiorespiratory arrest cases was foundwhich can suggest renal failure as an independent factor of increased mortality. Due to the contradiction in the results of some studies, perhaps a meta-analysis study on contradictory cases is more appropriate.

Keywords: Kidney disease, cardiopulmonary resuscitation, dialysis, ESRD

Introduction

Chronic diseases account for almost two-thirds of deaths worldwide and is undoubtedly a major challenge for global health (1). Chronic kidney disease (CKD) is a progressive and irreversible disease, as a result of which, the kidneys lose the ability to remove waste materials and maintain electrolytes, and this condition can lead to uremia. It is an irreversible and life-threatening disease, the only treatment for which is hemodialysis or kidney transplantation. CKD is a lifelong disease that requires interventions such as kidney transplantation, education, and restriction of food and fluid intake (2). The incidence and prevalence of CKD is increasing globally (3). The number of end stage renal failure (ESRD) cases in 2016 was reported to be about 3,730,000 people, considering the growth of 5.6% of affected people every year, it is considered one of the most important health problems in the world. In 2016, about 2,648,000 and 341,000people were treated with hemodialysis and peritoneal dialysis respectively. By the end of 2016, according to the annual US Kidney Data Report more than 661,000 Americans had kidney failure. CKD has been raised as one of the main health problems in Asian countries. According to the latest report in 2015 in Iran, the number of people with advanced kidney failure was about 58,000 and the number of people undergoing hemodialysis was 30,800 (4). The prevalence of CKD is variable in different regions of the world; So that the prevalence of CKD in Iran is 5.6-23.7% and in Mexico, it is estimated up to 33%. The prevalence of CKD has been associated with an increase in cardiovascular events, ESRD, and a high mortality rate (5). CKD is associated with an increase in mortality in all stages whether in the pre-dialysis stage or in the dialysis stage or after transplantation .Cardiovascular events are the main cause of death in these patients, so that the existence of CKD as a strong predictive factor of cardiovascular events has been suggested. ESRD is the ninth leading cause of death in the United States and is responsible for approximately 85,000 deaths per year in this country.

Sudden cardiac arrest is one of the most common health problems and one of the most important causes of death worldwide. Every year, more than 200,000 Americans suffer cardiac arrest in the hospital, and their survival rate is around 22% .Previous studies have shown that cardiac arrest among dialysis patients accounts for more than 17% of all in hospital cardiac arrests (20,13).

CPR consists of defined steps that are performed in patients with cardio-pulmonary arrest and is an attempt to artificially keep the circulatory and respiratory systems active to the extent that enough oxygen is provided to keep the body's vital systems alive until the physiological activity of the system returns to the normal state by itself (8). So far, there have been many improvements in the method, the drugs used and the skill of health providers but still the survival rate of discharged patients and their neurological prognosis is unfavorable (9).

Deaths that occur in the hospital are often related to severe underlying diseases. Kidney diseases are also among these diseases. The annual death rate of hemodialysis patients over the age of 20 is approximately 25 times higher than the general population. Patients with ESRD who are undergoing renal replacement therapy are at risk of death due

to heart diseases, 45% of the causes of death in these patients are due to heart diseases,20% of which include cases due to myocardial infarction and 60% of which is due to cardiac sudden death (10). Hemodialysis patients are one of the high-risk groups for out-of-hospital cardiac arrest (OHCA). Among hemodialysis patients, OHCA occurs 20 times more often than the general population and includes 0.25% of all deaths (6,11). Previous studies showed that only 56% of dialysis patients with OHCA survive to hospitalization, 24% survive to hospital discharge, and only 8% survive after one year(12).

Considering the importance of the resuscitation process in hospitals and the ethical and economic debatesabout it, in this study we decided to investigate the clinical consequences of cardiopulmonary resuscitation. In case of proving a strong relationship between the variables, it could develop a comprehensive guideline to carry out resuscitation (according to ethical criteria) and reduce the economic, physical and psychological burden imposed on hospitals and medical staff.

Methods

This descriptive-analytical retrospective study was conducted at a tertiary hospital in west of Iran. Chronic renal and dialysis patients referred to our center who underwent cardiopulmonary resuscitation during January 2021–December 2022 were included in the study. Demographic and clinical data of the patients were obtained from the registration data of the hospital in which patient information is prepared, collected, registered and stored in the form of an approved electronic questionnaire. In case of incomplete file, the patient was removed from the study.

In the descriptive analysis, central (mean-median) and dispersion (standard deviation) indicators were reported along with tables. Logistic regression was also used for analytical analysis. For analytical analysis, Chi-square test was used for qualitative data and independent t-test was used to compare quantitative data. If the initial assumptions were not met as normal, Mann-Whitney parametric test was used. P value < 0.05 was considered to be statistically significant.

The design was approved by the Ethics Committee of Kermanshah University of Medical Sciences [IR.KUMS.MED.REC.1402.132].

Results

Of 112 chronic renal and dialysis patients undergoing cardiopulmonary resuscitation,72 cases (64.3%) were men and 40 cases (35.7%) were women. The mean age of the subjects was 66.86 ± 18.08 years. The mean and standard deviation of the age of people by gender were 66.99±18.79 and 66.63±16.93 in men and women, and no statistically significant difference was found between the ages of men and women (p value=0.920).

47 of 72 men (65%) and 23 of 40 women (58%) had unsuccessful resuscitation. According to the chi-square test, the variables (gender, age,residence region, height, weight, BMI) had no significant difference in initial resuscitation result (table 1.1).

Of the initial successful resuscitation cases more than 75% of male and female patients died before being discharged from the hospital. In this group according to the chi-square test, the variables (gender, age, residence region, weight) had no significant difference in final outcome of patients (table 1.2).

According to the chi-square test, the variables (initial heart rhythm, hypertension, hyperlipidemia, history of (CVA, MI, cancer, drug poisoning), defibrillation and resuscitation place) had no significant difference in initial resuscitation outcome, (table 2).

In this study, the time interval from cardiac arrest to the first shock delivery in both successful and unsuccessful resuscitation groups did not follow the normal distribution. According to the Mann-Whitney test, there was no significant difference (P=0.287) (Table 3). In this study, the duration of CPR followed a normal distribution, The mean and standard deviation of CPR duration in successful resuscitations was 15.27±11.38 (minutes) and in unsuccessful resuscitations was 24.17±13.32. The duration of CPR in successful resuscitations was significantly different from unsuccessful resuscitations (P=0.001), so that the duration of successful resuscitation was almost 9 minutes less than unsuccessful resuscitation (Table 3).

Table 1.1-Individual characteristics of patients according to the initial result of resuscitation (successful/unsuccessful)

Individual characteristics \ ***Initial result***		***Successful***		***unsuccessful***		***P-value***
		number	Percent (%)	number	Percent (%)	
Gender	Male	25	34.73	47	65.27	0.415
	female	17	42.5	23	57.5	
Age	< 30	4	80	1	20	0.164
	30-45	1	16.7	5	83.3	
	45-60	5	31.2	11	68.8	
	60-75	21	43.8	27	56.2	
	>70	11	31.4	26	68.6	
Level of Education	High school and less	36	36.4	63	63.6	0.493
	Some academic	6	46.2	7	53.8	
Residence region	City	29	42	40	58	0.210
	village	13	30.2	30	69.8	

Height	<150	4	44.4	5	55.6	0.857
	150-165	12	42.9	16	57.1	
	165-175	21	34.4	44	65.6	
	>175	3	37.5	5	62.5	
Weight	<40	3	75	1	25	0.206
	40-55	5	35.7	10	64.3	
	55-75	16	30.2	37	69.8	
	>75	18	45	22	55	
BMI	<18.5	3	60	2	40	0.08
	18.5-24.9	16	30.2	37	69.8	
	25-29.9	8	29.6	21	70.4	
	30-39.9	10	62.5	8	37.5	
	>40	3	60	2	40	

Table 1.2-Individual characteristics of patients by final outcome(discharged/deceased)

Individual Characteristics / ***Final outcome***		**discharged**		**deceased**		**p-value**
		number	percent	number	percent	
Gender	Male	6	24	19	76	0.972
	female	4	23.5	13	76.5	
Age	<30	3	75	1	25	0.17
	30-45	1	100	0	100	
	45-60	2	40	3	60	
	60-75	3	14.2	18	85.8	
	>75	1	9	10	91	
Level of Education	High school and less	9	25	27	75	0.325
	Some	1	20	5	80	

	academic					
Residence region	city	6	20.5	23	79.5	0.478
	village	4	30.7	9	69.8	
Height	<150	1	25	3	75	0.528
	150-165	2	20	12	80	
	165-175	7	33.34	14	66.66	
	>175	0	0	3	100	
Weight	<40	1	33.34	2	66.66	0.526
	40-55	0	0	5	100	
	55-75	5	31.25	11	68.75	
	>75	4	22.2	14	77.8	
BMI	<18.5	0	0	3	100	0.297
	18.5-24.9	5	31.25	11	68.75	
	25-29.9	1	12.5	8	87.5	
	30-39.9	2	20	9	80	
	>40	2	33.3	1	66.6	

Table 2-Individual characteristics of patients according to the initial result of resuscitation (successful/unsuccessful)

Individual characteristics / ***Initial result***		***successful***		***unsuccessful***		***p-value***
		number	percent	number	percent	
Primary heart rhythm	VT + VF	4	66.7	2	33.3	0.133
	Asystole+ PEA	38	35.2	68	64.8	
HTN	yes	20	38.5	32	61.5	0.845
	No	22	36.7	38	63.3	
HLP	yes	8	29.6	19	70.4	0.332
	No	34	40	51	60	
History of CVA	Yes	2	28.6	5	71.4	0.473

	No	40	38.1	65	61.9	
History Of MI	Yes	9	34.6	17	65.4	0.729
	No	33	38.4	53	61.6	
History Of	Yes	40	38.1	65	61.9	0.473
brain Injuries	No	2	28.6	5	71.4	
History of	Yes	3	60	2	40	0.271
Cancer	No	39	36.4	68	63.6	
Drug	Yes	1	33.3	2	66.7	0.685
poisoning	No	41	37.6	68	62.4	
Witnessed	Yes	40	37.4	67	62.6	0.623
arrest	No	2	40	3	60	
Defibrillation	Yes	2	50	2	50	0.599
	No	40	37	68	63	
Resuscitation	ER	14	38.9	22	61.1	0.834
place	Other	28	36.8	48	63.2	

Table 3- Individual characteristics of patients by the initial result of resuscitation (successful/unsuccessful)

Variable	**result**	**SD ± mean**	**P-value**	**P-value normality**
Arrest to shock interval	successful	0.62±1.10	0.287	0.00
	unsuccessful	0.32±0.63		0.00
CPR duration	successful	15.27±11.38	0.001	0.999
	unsuccessful	24.17±13.32		o.438
Hemodialysis duration	successful	4.05±3.51	0642	0.109
	unsuccessful	3.76±2.84		0.358

Discussion

In our study, out of 112 cases who underwent CPR (36% women and 64% men), 42 cases (38%) were successful. Similar to the present study, Pan et al. (15) found an overall successful CPR of about 26% in their study. Jaberi et al (16) also showed in their study that

out of 302 resuscitation cases (54% women and 46% men), 72 resuscitation cases (24%) had initial success and 10 resuscitation cases (3%) had final success. A Canadian study showed that about 12% of patients with CKD had successful CPR (17).

In the present study, sex, age, education level, region of residence, height, weight and BMI of patients had no significant difference in resuscitation initial result. Findings of Sharma et al. (13) study were quite similar to ours. Unlike the present study, some other studies have reported worse outcomes with increasing age and female gender (18). Contrary toour findings, Fahad Saeed et al.(20) showed in their study that older age was associated with lower CPR success. Such findings are consistent with literature that increasing age is an important risk factor for in-hospital mortality (19,20). Data from the general population also confirm these findings (21,22).

Our findings showed that the primary heart rhythm, high blood pressureand lipids, previous CVA and myocardial infarction (MI), history of brain injuries, history of cancer, drug poisoning, duration of dialysis, and the witnessed arrest had no significant difference in resuscitation initial result. Consistent to our results, Pan et al.'s study (15) also did not show a significant relationship between the success rate of CPR and the early detection of cardiac rhythm after monitoring and using a cardiac defibrillator. In the study by Sharma et al. (13), sepsis was mentioned as the most important cause of death. It was found that the association of patient characteristics such as presence or absence of chronic kidney disease, type of dialysis treatment with successful CPR is insignificant. Other factors such as out-of-hours of ICU admission arrest, early intubation, and inotrope initiation were associated with poorer outcomes. Studies show that as the dialysis period increases, the patient's survival decrease and the outcome of resuscitation is poorer. Several studies have identified increased mortality in patients with pre-existing CKD (23,24). The results studies showed that the mortality rate was higher in patients with CKD who underwent CPR compared to patients who did not have such kidney problems (14,25). Contrary to the results of our study, Esfahani et al showed that the presence of an underlying disease will increase the failure rate of resuscitation (26, 27). In our study the time interval from arrest to the start of resuscitation, first defibrillation and the place where resuscitation was done, did not have a significant difference in the initial result of resuscitation. The duration of CPR had a significant difference in the initial result of resuscitation, so that the duration of successful resuscitation was almost 9 minutes less than unsuccessful resuscitation. Both early and late mortality were higher in longer CPR. Consistent with the results of our study, Ballew et al (28) observed that 45% of patients survived to discharge when the duration of CPR was less than 5 minutes, and less than 5% of patients survived when the duration of CPR was more than 20 minutes. Sharma et al (13) showed that patients who survived to discharge were almost always resuscitated within 15 minutes of the onset of cardiac arrest. The average duration of CPR in survivors was 10.4 minutes compared to 27.1 minutes in non-survivors. survivors with a shorter CPR duration had a significantly better neurologic outcome(29,30). Time of first defibrillation made no statistically significant difference in survival to discharge. Some studies have reported a survival rate of up to 41% for patients presenting with a shockable rhythm as the primary rhythm (31,32).

Conclusion

In our findings, gender, age, education level, region of residence, height, weight and BMI, primary heart rhythm, high blood pressure and lipids, previous CVA, myocardial infarction (MI) and brain injuries, history of cancer, drug poisoning, duration of dialysis and witnessed arrest, time interval from arrest to resuscitation, first shock and place of resuscitation had no significant difference in outcome, only the duration of resuscitation had a significant relationship with the outcome with decreased success in longer CPR.

Limitations

Retrospective design of our study precluded measurement and adjustment for confounding factors such as experiences, quality, timing, or appropriateness of care at hospital centers that were not included in the databases. Since our patients had renal disease, treatment of potential acidosis and hyperkalemia during the cardiac arrest are important parameters that need to be studied. CPR quality indicators were not studied. Quality of life after resuscitation, including neurological outcomes, also needed to be analyzed.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Funding

None

Author contribution

Dr. ShahrouzTabrizi: conceptualized and designed the study, reviewed and revised the manuscript.

Dr. FarshidMirzaii: Designed the data collection instruments, collected data and drafted the initial manuscript

Dr. AkramZolfaghariSadrabad: Coordinated and supervised data collection, and critically reviewed the manuscript for important intellectual content.

Dr. MohammadrezaFarnia: conceived the study and was in charge of overall direction and planning

Dr. BarrezaRezaei : aided in interpreting the results and worked on the manuscript

Declaration of competing interest

The authors deny any conflict of interest in any terms or by any means during the study**.**

Guarantor

Dr. ShahrouzTabrizi

Provenance and peer review

Not commissioned, externally peer-reviewed

Human and animal rights

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

Availability of data and materials

All relevant data and materials are provided with in manuscript.

References

1. Bauer UE, Briss PA, Goodman RA, Bowman BA. Prevention of chronic disease in the 21st century: elimination of the leading preventable causes of premature death and disability in the USA. The Lancet. 2014;384(9937):45-52.
2. Bakarman MA, Felimban MK, Atta MM, Butt NS. The effect of an educational program on quality of life in patients undergoing hemodialysis in western Saudi Arabia. Saudi medical journal. 2019;40(1):66.
3. Ranabhat K, Mishra SR, Khanal P, Adhikari BR, Sigdel MR, Pradhan B. HEALTH RELATED QUALITY OF LIFE AMONG HAEMODIALYSIS AND KIDNEY TRANSPLANT RECIPIENTS FROM NEPAL: A CROSS SECTIONAL STUDY USING WHOQOL-BREF. Journal of Hypertension. 2021;39:e297.
4. Cobb J, Plantinga L, Luthi J-C, Lynch JR, Huff ED, Mohan S, et al. Pre-ESRD care and mortality in incident ESRD patients with multiple myeloma. American journal of clinical oncology. 2018;41(4):367-70.
5. Guessous I, McClellan W, Vupputuri S, Wasse H. Low documentation of chronic kidney disease among high-risk patients in a managed care population: a retrospective cohort study. BMC nephrology. 2009;10:1-10.
6. Makar MS, Pun PH. Sudden cardiac death among hemodialysis patients. American Journal of Kidney Diseases. 2017;69(5):684-95.
7. Wong SP, Kreuter W, Curtis JR, Hall YN, O'Hare AM. Trends in in-hospital cardiopulmonary resuscitation and survival in adults receiving maintenance dialysis. JAMA internal medicine. 2015;175(6):1028-35.
8. Merchant R, Yang L, Becker L, Berg R, Nadkarni V, Nichol G, et al. American Heart Association get with the guidelines-resuscitation investigators: incidence of treated cardiac arrest in hospitalized patients in the United States. Crit Care Med. 2011;39(11):2401-6.
9. Soar J, Nolan JP, Böttiger BW, Perkins GD, Lott C, Carli P, et al. European resuscitation council guidelines for resuscitation 2015: section 3. Adult advanced life support. Resuscitation. 2015;95:100-47.
10. Tsai JC-H, Ma J-W, Liu S-C, Lin T-C, Hu S-Y. Cardiac Arrest Survival Postresuscitation In-Hospital (CASPRI) Score Predicts Neurological Favorable Survival in Emergency Department Cardiac Arrest. Journal of Clinical Medicine. 2021;10(21):5131..
11. Cefalu WT, Andersen DK, Arreaza-Rubín G, Pin CL, Sato S, Verchere CB, et al. Heterogeneity of diabetes: β-cells, phenotypes, and precision medicine: proceedings of an

international symposium of the Canadian Institutes of Health Research's Institute of Nutrition, Metabolism and Diabetes and the US National Institutes of Health's National Institute of Diabetes and Digestive and Kidney Diseases. Diabetes. 2022;71(1):1-22.
12. Kudenchuk PJ, Stuart R, Husain S, Fahrenbruch C, Eisenberg M. Treatment and outcome of out-of-hospital cardiac arrest in outpatient health care facilities. Resuscitation. 2015;97:97-102.
13. Sharma S, Raman P, Sinha M, Deo AS. Factors Affecting Outcomes of Cardiopulmonary Resuscitation in a Nephro-Urology Unit: A Retrospective Analysis. Indian journal of critical care medicine : peer-reviewed, official publication of Indian Society of Critical Care Medicine. 2022;26(3):322-6.
14. Abassi NH, Ali QT, Shah BG. Survival Outcomes of Cardiopulmonary Resuscitation in the Patients Diagnosed with Chronic Kidney Disease. Pakistan Journal of Medical & Health Sciences. 2022;16(05):1561-.
15. Pun PH, Dupre ME, Starks MA, Tyson C, Vellano K, Svetkey LP, et al. Outcomes for hemodialysis patients given cardiopulmonary resuscitation for cardiac arrest at outpatient dialysis clinics. Journal of the American Society of Nephrology. 2019;30(3):461-70.
16. J Jabri, Yahya, Cengizian, Lida, Zadeh M. Investigating the success rate of in-hospital cardiopulmonary resuscitation and its related factors ournal of Advances in Medical and Biomedical Research. 2011;19(75):48-57.
17. Thel MC, Armstrong AL, McNulty SE, Califf RM, O'Connor CM. Randomised trial of magnesium in in-hospital cardiac arrest. The Lancet. 1997;350(9087):1272-6.
18. Lafrance J-P, Nolin L, Senecal L, Leblanc M. Predictors and outcome of cardiopulmonary resuscitation (CPR) calls in a large haemodialysis unit over a seven-year period. Nephrology Dialysis Transplantation. 2006;21(4):1006-12.
19. Starks MA, Wu J, Peterson ED, Stafford JA, Matsouaka RA, Boulware LE, et al. In-hospital cardiac arrest resuscitation practices and outcomes in maintenance dialysis patients. Clinical Journal of the American Society of Nephrology: CJASN. 2020;15(2):219.
20. Saeed F, Adil MM, Kaleem UM, Zafar TT, Khan AS, Holley JL, et al. Outcomes of in–hospital cardiopulmonary resuscitation in patients with CKD. Clinical journal of the American Society of Nephrology: CJASN. 2016;11(10):1744.
21. Chan PS, McNally B, Nallamothu BK, Tang F, Hammill BG, Spertus JA, et al. Long-term outcomes among elderly survivors of out-of-hospital cardiac arrest. Journal of the American Heart Association. 2016;5(3):e002924.
22. Libungan B, Lindqvist J, Strömsöe A, Nordberg P, Hollenberg J, Albertsson P, et al. Out-of-hospital cardiac arrest in the elderly: a large-scale population-based study. Resuscitation. 2015;94:28-32.
23. Kim AJ, Lim HJ, Ro H, Jung JY, Lee HH, Chung W, et al. Liver cirrhosis leads to poorer survival in patients with end-stage renal disease. The Korean journal of internal medicine. 2016;31.
24. Howard CS, Teitelbaum I, editors. Renal replacement therapy in patients with chronic liver disease. Seminars in Dialysis; 2005: Wiley Online Library.

25. Uduagbamen PK, Bamikefa TA, Oyelese AT, O SA, Ano-Edward GH, Adeleke AA, et al. Antiplatelet Therapy and Kidney Function in Non-Dialysis Chronic Kidney Disease: A Two-Centre Observational Study in Nigeria. Int J Pharm Res Allied Sci. 2024;13(2):86-96. https://doi.org/10.51847/EbWPUU4ekG
26. Esfahani MN, Javari A, Heydari F, Javari M. Evaluation of effective factors in the success of resuscitation of patients with in-hospital cardiopulmonary arrest. Tehran University of Medical Sciences Journal. 2022;80(4):313-22.
27. Lakshmi JN, Sai PC, Sowjanya P, Babu PS, Kanneganti S, Thalla S. Hepatoprotective Activity of Calycopteris floribunda on Clopidogrel and Atorvastatin Induced Hepatic Damage in Rodents. Int J Pharm Res Allied Sci. 2024;13(2):41-7. https://doi.org/10.51847/gUPjslvJL7
28. Ballew KA, Philbrick JT, Caven DE, Schorling JB. Predictors of survival following in-hospital cardiopulmonary resuscitation: a moving target. Archives of internal medicine. 1994;154(21):2426-32.
29. Welbourn C, Efstathiou N. How does the length of cardiopulmonary resuscitation affect brain damage in patients surviving cardiac arrest? A systematic review. Scandinavian journal of trauma, resuscitation and emergency medicine. 2018;26(1):1-13.
30. Levochkina ED, Belyaev NG, Tkach AI, Menadzhiev AS, Volkova MN, Akifeva NM, et al. Data analysis of autoimmune bioindicators in the context of predicting cardiomyocyte damage. J Adv Pharm Educ Res. 2024;14(3):62-9. https://doi.org/10.51847/ilO1LTBQLt
31. Hirlekar G, Karlsson T, Aune S, Ravn-Fischer A, Albertsson P, Herlitz J, et al. Survival and neurological outcome in the elderly after in-hospital cardiac arrest. Resuscitation. 2017;118:101-6.
32. Wani FA, Thirunavukkarasu A, Alzarea NA, Alzarea WA, Alshaya OM, Alanazi AFB, et al. Hospitalized COVID-19 Patients Characteristics, Comorbidities, and Outcomes: A Retrospective Study. Arch Pharm Pract. 2023;14(3):70-6. https://doi.org/10.51847/meIKV96yQX