In-hospital cardiac arrest epidemiology and intervention

(a cross-sectional survey of In-Hospital cardiac arrest cases at a secondary healthcare facility in the city of Sirte over a time period from Juli the 1st 2022 to March the 20th 2023)

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ABSTRACT

Introduction: Sudden cardiac arrest (SCA) is the abrupt loss of all cardiac activities as a result of acute heart rhythm disturbance and cessation of respiration, it is the most critical condition that faces any healthcare system, and that requires accurate precise coordinated intervention to achieve a favourable outcome. The epidemiological figures and the survival rates of in-hospital cardiac arrest vary significantly between developed and developing countries owing to the availability of rapid response resuscitation teams and advanced healthcare facilities. This study dictated to examine the epidemiology and the intervention aspects of in-hospital cardiac arrest in the city of Sirte at Ibn Sina Teaching Hospital.

Methods: This study is a cross-sectional survey, dedicated to examining the epidemiological and intervention data of in-hospital cardiac arrest at IBN SENA TEACHING HOSPITAL in the city of Sirte, used a data collection form that included details of interest, a total of 591 files for patients who were admitted to the intensive care unit during the study period, 50 cases of cardiac arrest were registered and included in this study for analysis.

Results: a total of 50 cases, with an overall incidence of 5.4 cardiac arrests for every 1000 admissions. males were arrested more than females during the study period; 66% males (34 cases) and 32% females (16 cases), the age group that has the highest frequency of cardiac arrest was (>75 years old) group for both sexes, and almost all of the registered cases were in the ICU, even though only 23 cases 46% were resuscitated, respiratory system diseases were the most frequent aetiology for cardiac arrest during the study period, followed by trauma and came 3rd the cardiovascular system diseases, Concomitant comorbidity of HTN and DM represents the most frequent pre-arrest illnesses which, and finally the survival rates were zero. Very important data were missed/undocumented that could improve the survival rates in one way or the other

1.Inroduction

Cardiac arrest is defined as an abrupt or sudden and complete cessation of cardiac pump function (cardiac output), which may be reversible by a prompt intervention (immediate high-quality resuscitation) but will lead to death in its absence 1,2. Electro-physiologically the most frequent mechanisms of cardiac arrest (leading to SCD) are either ventricular tachyarrhythmias [ventricular fibrillation (VF) or ventricular tachycardia (VT)] or pulseless electrical activity (PEA) and asystole (or other bradycardias that

result in loss of adequate cerebral and other organ perfusion)2,3. According to their response to electrical shock, those rhythms are classified as Shockable rhythms (the former two) and non-shockable rhythms (the latter two). The identification of each rhythm is crucial to tailor the proper management during cardiopulmonary resuscitation. Several studies have been conducted to examine the prevalence of arrest rhythm. Allencherril, J. et al 2022 4, for instance, in a meta-analysis revealed that in 69.83% of cases, an

unshockable rhythm (pulseless electrical activity or asystole) was recorded, while a shockable rhythm (ventricular tachycardia or ventricular fibrillation) was recorded in 21.75% of cases. Cardiac arrest could result from medical and traumatic causes, medical illnesses can be either cardiac or non-cardiac, most cardiac reasons are thought to be due to ischemic coronary disease 6 and other structural causes, while the non-cardiac causes of cardiac arrest varied significantly and (as a cardiac consequence of primary noncardiac conditions), yet the pulmonary (hypoxic) cause has become the most frequent aetiology for cardiac arrest followed by cardiac causes either in hospital or out hospital cardiac arrest, (Allencherril, J. et al 20224, Wallmuller, C et al 20125 Perman, S. M et al 20166, Radeschi, G. et al 20177 and Bergum, D. et al 20158). Cardiac arrest among hospitalised patients is the most challenging point that faces intensive care and emergency teams worldwide since the immediate and adequate intervention is reflected directly in the rates of incidence and survival of cardiac arrest cases, globally in-hospital cardiac arrest contributes to 80% of total in-hospital mortalities and it is estimated at 1-5 patients per 1000 hospital admissions [9]. Regionally the incidence and the survival rates of cardiac arrest in hospitals varied significantly. those are some examples: In the UK ROSC is achieved in 53% of IHCA and a total of 23.6% of total hospital resuscitation survive until hospital discharge, 83% of them discharged with a favourable neurological outcome[10]. While in the USA, it lastly stood at 25%[11]. While In Sweden the survival rate of in-hospital cardiac arrest was 24%[12], the figures in Denmark were 50.2% of total in-hospital arrests[13].

The researcher dictated this research to study the incidence and the outcome of in-hospital cardiac arrest in the main hospital of the study area (IBN SENA TEACHING HOSPITAL in the city of Sirte), applying a cross-sectional survey method and using a researchers' designed data collection form designed to cover the epidemiological and the intervention aspects of cardiac arrest events in the area of study.

2. Methods

This study is a cross-sectional survey, dedicated to examining the epidemiological and intervention data of in-hospital cardiac arrest at IBN SENA TEACHING HOSPITAL in the city of Sirte (a city with an estimated population of 170869 in 2020 according to the Buru of statistics and census in Libya[14]), including the most frequent arrest rhythm, the aetiology precipitating factors, pre-arrest morbidities, the time of occurrence of arrest, the site of the arrest and the time from the arrest to intervention, the nature of the intervention (medications, DC/AED, invasive mechanical life support machines), and finally the outcome of the arrest among different age groups, over a time period from 1/7/2022 to 20/3/2023.

The data was collected in a checklist which included the following items: Hospital, the patient's Gender and age, the location of arrest, whether was it attended or not, the time of arrest, and whether cardiopulmonary resuscitation was done

or not. the time taken to start CPR, the aetiology of arrest and the pre-arrest illness, Intervention before the arrest, the arrest rhythm, duration of CPR (minutes), Intervention during CPR, Drugs used during CPR, and Reason for CPR termination.

591 files for patients who were admitted to the intensive care unit out of a total of 9177 cases of all causes of hospital admissions were reviewed, and 50 cases of cardiac arrest were registered and included in this study for analysis. The researcher compared the figures for admissions and cardiac arrest cases with the registry of other hospital departments to avoid data missing. 50 data collection forms were then transferred and analysed using the SPSS program.

3. Results

The total number of cases of cardiac arrest that were analysed by this study was 50 cases, all of the cases were admitted to the intensive care unit of IBN SENA TEACHING HOSPITAL SIRTE, and their gender distribution was 68% males (34 cases) and 32% females (16 cases), figure 1:
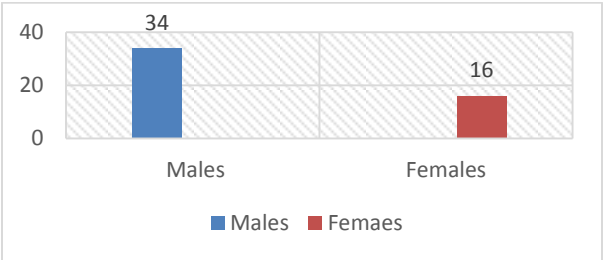

Fig 1. Gender distribution

By revising the total hospital admissions during the period of 1/7/2022 to 31/3/2023 the total number of all causes admissions was 9177 admissions. a total of 591 files for patients who were admitted to the intensive care unit during the study period were identified, and 50 cases of cardiac arrest were included in this study. This gives averages of the average of monthly admissions to the different units of Ibn Sina Hospital equals 1019 cases and 65 ICU admissions monthly, 5.5 arrests monthly. which gives an incidence of 5.4 cardiac arrests for every 1000 admissions.

Recorded cases were allocated into 7 age groups as shown in figure 2: the frequencies of the age groups were: 22 out of 50 cases belong to the eldest age group (older than 75) at 44%, age groups 56-65 and 66-75 have the same frequency of 8 cases and at a percentage of 16%, the age group (46-55) showed a frequency at 8% of 4 cases, while the following younger age groups 36-45, 26-35, 6-15 and younger than five have frequencies of 4%, 3%, 0% and 2% respectively.
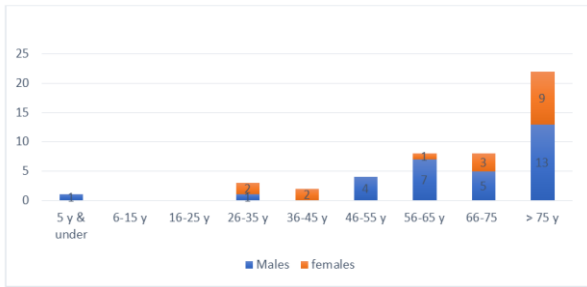
Fig 2. Age groups & gender distribution

The aetiology of Cardiac arrest among the reported cases varied between many causes but respiratory system diseases were the most frequent cause of cardiac arrest during the period of the survey representing a fraction of 10%, followed by trauma (head injury mostly) at 8% of the cases, and it is of notice that surgical/trauma aetiology was recorded only in male patients among the survived cases, the 3rd most frequent cause of cardiac arrest was cardiovascular system diseases with a percentage of 7%, then followed by equal frequencies of aetiology for malignancies, cerebrovascular, hepatic, and a concomitant diseases of cardiovascular and cerebrovascular and a concomitant diseases of respiratory and renal diseases at 4% each, other causes with lesser extent shown in figure 3.
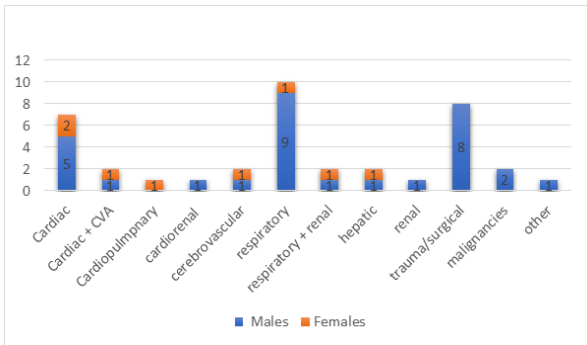

Fig 3.The etiology of Cardiac arrest

As a risk factor for cardiac arrest, prearrest illnesses were screened and their frequencies were: On top of all chronic illnesses, a concomitancy of diabetes mellitus and hypertension were the most common chronic illness among the study sample total cases of 8 (at a percentage of 18%), the second most frequent prearrest illness was the malignancies in general at 5 cases (10% of total cases) and respiratory malignancies in particular in other 2 cases (at 4%), followed by hypertension as a single disease in 4 cases (at 8% of cases), and in concomitance with chronic obstructive pulmonary disease in only one case (2% of cases). to a lesser extent diabetes was recorded as a single illness in 2 cases at a percentage of 4%. Respiratory illnesses in general recorded in 4 cases representing 8% of the total cases (respiratory failure 1 case, bronchial asthma 1 case, respiratory malignancy 2 cases and COPD in association with HTN in one case), the rest of the recognised prearrest illnesses and their frequencies
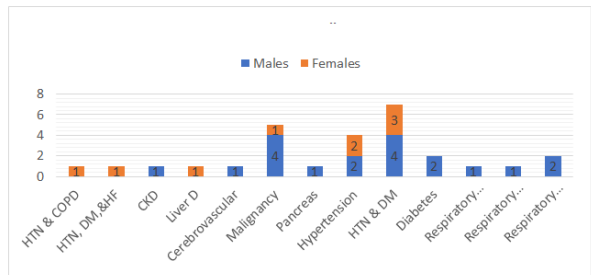
shown in details in figure 4 :

Fig 4. Pre-arrest illnesses

Regarding the location of cardiac arrest: 48 out of the total cases were arrested at the intensive care unit with only 1 case arrested at the cardiac intensive care unit as shown in Figure 5 :
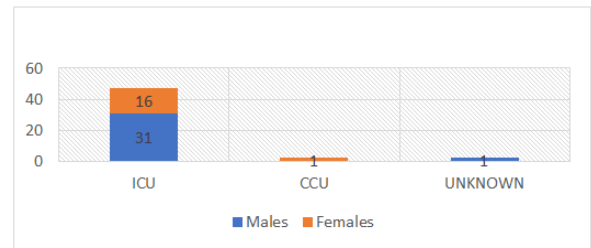

Fig 5. location of arrest events

The cardiac arrest events were mentioned as (witnessed) in only 15 out of the total cases at 17.6% of the total cases (12 males and 3 females arrests). Having said that, out of the total 50 cases of cardiac arrest that were registered, only 23 cases were resuscitated (16 males and 7 females), while the rest there was a decision to not resuscitate. For those who were resuscitated, the time taken from arrest to CPR was mentioned only in one case (at a percentage of 2%) which was between 3 to 5 minutes, while it was not documented for the rest of the cases (98% of the cases).

In addition, among the 50 recorded cases, the duration of CPR was mentioned only once and it was 10 minutes, and for the rest of the cases, the duration of CPR was not recorded. The arrest rhythm which was supposed to be either shockable (VT/VF) or non-shockable (Asystole/PEA) was never mentioned in the resuscitation notes of all the cases under study.

During CPR in the resuscitated cases, an invasive intervention (intubation and mechanical ventilation) was mentioned in only one case (at 4.4% out of the resuscitated cases). Resuscitation drugs were used during the resuscitation of 6 cases at frequencies of Adrenalin in one case (4.4%), Atropine in 2 cases (8.7%) and both Adrenaline and Atropine used in the resuscitation of 3 cases (13%).

Regarding the outcome of CPR (the reason for termination of CPR) all the recorded cardiac arrest patients either those who were resuscitated or those who were not resuscitated reportedly died.

The missed data: during data collection numerous important data were not documented or were missed during the time of documentation of cardiac arrest cases, those missed data and

their frequencies are shown in the next table:

Table 1. The missed data and their frequencies among the surveyed cases

PARAMETERS	RECORDED DATA	MISSED DATA
Aetiology	39 (78%)	11 (22%)
Pre-arrest illness	28 (56%)	22 (44%)
Attended/not attended CPR	15 (30%)	35 (70%)
Time of arrest	16 (32%)	34 (68%)
Time to CPR	2 (4%)	48 (96%)
Intervention before CPR	0	50(100%)
Arrest Rhythm	0	50 (100%)
Duration of CPR	1 (2%)	49 (98%)
Intervention during CPR	1 (2%)	49 (98%)
Medications used in CPR	6 (22%)	44 (88%)

4. Discussion

An overall incidence of cardiac arrest at Ibn Sina Hospital of 5.4/1000 admissions is significantly more than the figures of the global estimated figures[9] and figures from UK[10], Japan[15], Korea[16], and Denmark[13] but it is less than those of the USA's[11] and the UAE[17], which put the results of this research at the expected average of incidences.

The survival rate of this study was zero, as neither the resuscitated nor those who were not resuscitated survived the cardiac arrest condition and ended up with them declared dead, comparing this to the figures of different worldwide countries which recorded the highest reviewed rate of 60% at a tertiary health care facility in India[18] and the lowest survival rate among the reviewed researches at 24% in Sweden[12], this reflects a significant defect in the process of recognition and management of this health condition.

The gender distribution of the studied cases came consistence with the figures from most reviewed research worldwide that showed a male predominance of the cardiac arrest cases[11,19,10,20,16,21,21,19,18,17,22].

Regarding the age group with the most frequent cardiac arrest, in this study it was in the eldest age group (older than 75) with the frequency increasing steadily from the age of 56 years, those were very similar to the figures of the UK[10], the even though most of the cases arrested in the intensive care unit (96% of the cases) and at least 30% of the arrests were witnessed, which could cast doubt on the CPR at the intensive care unit under study. Substantial information on the time of arrest, time taken to CPR, the arrest rhythm, duration of CPR, intervention before, during and after and drugs given during CPR, which could have a direct consequence on the survival rates[24,25,26], were missed either poorly documented or omitted. Danish DANARREST[13], the USA's[23], Taiwan[21], Italy[7] and UAE[17], but in Japan the arrest was more frequent in much older age group (at age 80-89)[15].

Among the cases under study, only 46% were resuscitated

Comparing the aetiological factors between this study and the reviewed studies revealed that the pulmonary/hypoxic causes were the most common aetiology of in-hospital arrest in this study and **Allencherril, J. et al 2022**[4], the UK's resuscitation Council, **Wallmuller, C et al 2012**[5] from Austria and **Ohbe, H. et al 2022**[15] from Japan. While cardiac disease was the most frequent cause of arrest in other reviewed studies such as: from UAE, **Alao, D. O et al 2022**[17] and **Bergum, D. et al**

2015[8] from Norway. In addition, trauma as the second major cause of cardiac arrest in Sirte was not compared to the frequencies of the medical causes of arrest by other studies.

Pre-arrest illnesses as a risk factor or indicators for arrest prognosis were examined by this study and the most frequent was concomitant comorbidity of DM and HTN followed by malignancies, which fall under the same criteria as the findings of the two meta-analyses which were reviewed namely **Fernando, S. M. et al 2019**[26] and **Van Ravenhorst, C. G et al 2023**[27].

5. Study's limitations:

The missed data table illustrated the frequencies of undocumented data among the patients under study reflects a serious defect in the documentation process of the cardiac arrest cases in the intensive care unit which in turn means that this process is nowhere near any of the reviewed literature[17,28,29,30,31].

6. Conclusion

The overall incidence of IHCA in the study area during the study period was 5.4 cardiac arrests for every 1000 admissions. With male predominance at the age group of (>75 years old) for both sexes, respiratory system diseases were the most frequent aetiology for the clinical condition under study, with the concomitant comorbidity of HTN and DM represents the most frequent pre-arrest illnesses. The lack of standard documentation resulted in inadequate data regarding the intervention and the survival of the incident.

It could be recommended that applying a standard registration form for cardiac arrest cases could yield high-value statistical data.

Further studies:

Resuscitation skills evaluation among healthcare providers working in the facility under study could be evaluated and accordingly, resuscitation training could be needed. Standardisation of IHCA documentation is very important to tackle the issue of missed data. Large-scale registries such as the Nationwide open registry for IHCA are very important for providing a reliable database for any further study

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