Restoring health and hope to displaced Gaza children with malignant disease at a cancer centre in Jordan

Rawad Rihani[1], Sima Jeha[2], Zeena Salman[2], Shrouq Amer[1], Ibrahim Qaddoumi[2], Carlos Rodriguez-Galindo[2] and Asem Mansour[1]

[1]King Hussein Cancer Center, Amman, Jordan (Correspondence to Rawad Rihani: rrihani@khcc.jo). [2]St Jude Children's Research Hospital, Memphis, Tennessee, USA.

Abstract

Background: Gaza children with cancer have faced critical delays in diagnosis and treatment due to the conflict, leading to late-stage presentation.

Aim: To assess the impact of disruptions on treatment outcome for Gaza children with cancer treated at King Hussein Cancer Center in Amman, Jordan.

Methods: We collected and analysed data from Gaza children aged 0–21 years with malignant disease, who were evacuated and received treatment at King Hussein Cancer Center between October 2023 and October 2024. We used the Kaplan–Meier survival estimates to analyse their overall survival rate.

Results: Fifty-one Gaza children received treatment for cancer at the centre during the study period; median age 8.2 years, 66.7% male. Of the cases, 25.5% were newly diagnosed, 11.8% were relapsed and 62.7% had been previously treated in Gaza; 39.2% had leukaemia and 21.6% had solid tumours. Their referral had been delayed by 3–4 months, and at presentation, 51% exhibited psychological distress and 27.5% were underweight. After 4 months of follow-up, 96% survived.

Conclusion: Most of the children experienced delays in diagnosis, referral and treatment and these impacted their treatment outcomes. Well-coordinated strategies such as streamlined referral systems, cross-border collaborations and timely medical evacuations through protected humanitarian corridors are crucial to provide life-saving care for paediatric cancer patients in Gaza and similar conflict zones.

Keywords: children, paediatric, cancer, oncology, malignant disease, conflict zone, humanitarian response, late-stage presentation, Gaza, Jordan

Citation: Rihani R, Jeha S, Salman Z, Amer S, Qaddoumi I, Rodriguez-Galindo C, Mansour A. Restoring health and hope to displaced Gaza children with malignant disease at a cancer centre in Jordan. East Mediterr Health J. 2025;31(4):243–249. https://doi.org/10.26719/2025.31.4.243.

Received: 03/11/2024; Accepted: 16/03/2025

Introduction

Cancer is the third leading cause of death in Gaza; it accounted for 14.1% of all deaths in 2020 *(1)*. Each year, 210 children are diagnosed with cancer in Gaza and they often require referral abroad due to inadequate treatment and care services such as shortage of drugs and diagnostics including radiotherapy. A study reported that all 131 children with acute lymphocytic leukaemia in Gaza required treatment abroad at least once due to limited treatment resources, while 52% required referral multiple times *(2)*. As a Gaza refugee host country, many of such children are often referred for treatment in Jordan. Between 2011 and 2022, King Hussein Cancer Center (KHCC) in Amman, Jordan, treated 968 immigrant paediatric patients and King Hussein Cancer Foundation (KHCF) financially supported 84% of those treatments *(3)*.

Gaza's health system has been weakened by years of conflict and faces severe cancer care challenges *(4)*. WHO estimates that nearly 50% of oncology patients in Gaza cannot access timely treatment due to limited resources, damaged facilities and movement restrictions *(5)*. Paediatric oncology patients are especially vulnerable due to delays in diagnosis, chemotherapy shortages and inadequate follow-up care. WHO and partners have been facilitating patient transfers and delivery of essential services for paediatric cancer patients in Gaza, but the blockades and incessant military operations often make these impossible or delayed *(5)*.

Refugee children often present with advanced cancers requiring intensive care due to delays in diagnosis and treatment caused by conflict, disruptions and restrictions on patient evacuation abroad *(4)*. Worsened treatment outcomes due to system disruptions have been reported among Syrian refugees *(6)*. The unique geopolitical situation, isolation and limited resources have added to the complexity of the situation in Gaza, prompting the call by WHO for safe evacuation corridors for timely transfers *(5)*.

KHCC, a regional leader in cancer care, has been receiving paediatric oncology patients from Gaza in coordination with WHO and humanitarian agencies such as KHCF, St Jude Children's Research Hospital and American Lebanese Syrian Associated Charities (ALSAC). This report documents the challenges faced by displaced paediatric cancer patients evacuated for treatment at KHCC and the critical role of partnerships with international institutions like St Jude and KHCF in delivering essential care to these vulnerable children, who often present with advanced-stage cancers due to treatment delays.

Methods

Using mixed methods, we collected and analysed clinic data and insights from case reviews and experiences of paediatric oncology patients aged 0–21 years who were evacuated from Gaza and received treatment at KHCC between October 2023 and October 2024. Eligibility criteria were, diagnosis of a malignant disease requiring oncology care and evacuation prompted by the conflict and disruptions to local health care services. We included only patients whose comprehensive clinic data were available for outcome analysis.

Patients' data were systematically collected from the electronic medical records and referral notes presented to KHCC. These included the patient's demographics, referral time, initial and confirmed diagnosis, cancer stage at presentation, treatment timeline, treatment outcome, hospitalization (including paediatric intensive care unit admission), and nutritional and psychological assessments. The data were analysed and presented as medians with interquartile ranges and categorical variables were summarized as numbers and percentages. Overall survival was defined as the proportion of patients alive at the end of the study period. Kaplan–Meier survival estimates were generated to analyse the overall survival rate, using the date of presentation at KHCC as the starting point and death from any cause as the endpoint.

Results

Characteristics of the patients

Fifty-one children were evacuated and treated at KHCC under the KHCC/St Jude Gaza humanitarian treatment initiative. The median age at the time of diagnosis in Gaza was 6.7 (range 0.15–21.3) years and at presentation to KHCC 8.2 (range 0.6–21.4) years (Table 1). Of these, 34 (66.7%) were males. At presentation to KHCC, 13 (25.5%) of the patients were newly diagnosed, of which 7 (53.8%) had no previous history of treatment and 6 (46.2%) had previously received treatment. Thirty-two (62.7%) patients had pre-existing cancer for which they received some treatment in Gaza and 6 (11.8%) presented with relapsed disease (Table 2). Out of 50 of them, 20 (39.2%) were diagnosed with acute leukaemia, 11 (21.6%) with solid tumours, 7 (13.7%) with central nervous system tumours, 4 (7.8%) with histiocytic disorder, 5 (9.8%) with lymphoma, and 3 (5.9%) with retinoblastoma (Table 2).

Delays in presentation at KHCC

The median number of days from diagnosis to presentation at KHCC was 196 days (range 16–1905 days) and the median number of days from referral to presentation at KHCC was 21 (range 1–152 days). Upon arrival, 28 (55%) patients were in remission, including 15 (29.4%) who were off therapy and required follow-up,

Table 1. Demographic characteristics of of paediatric cancer patients from Gaza (N = 51)

Characteristic	Median (range)	Number (%)
Average age (years)		
At initial diagnosis in Gaza	6.7 (0.15–21.3)	
At relapse/new diagnosis in Gaza	6.7 (0.15–21.3)	
At presentation at KHCC	8.2 (0.6–21.4)	
Average number of days before presentation		
Diagnosis to presentation at KHCC	196 (16–1905)	
Referral to presentation at KHCC	21(8–152)	
Gender		
Male		34 (66.7)
Female		17 (33.3)
Status of admission		
Inpatient admission		19 (37.3)
PICU admission		7 (13.7)
Floor admission		12 (23.6)
Outpatient		32 (62.7)
Nutritional status at presentation to KHCC		
Underweight (<5th percentile)		14 (27.5)
Adequate weight (5th–95th percentile)		34 (66.6)
Overweight (>95th percentile)		3 (5.9)
Distress thermometer scale at presentation to KHCC*		
<6		25 (49)
≥6		26 (51)

*Distress thermometer scale score from (0-10), (0 indicates no distress, 10 indicates extreme distress). Distress thermometer scale ≥6 indicates highly distressed.

KHCC = King Hussein Cancer Center

while 23 (45%) had active or relapsed disease (Table 2). The majority (70%) of them presented with distant surveillance, epidemiology and end results (SEER) stage disease (Table 2). Fifteen (88.2%) of the 17 patients who arrived within the first 3 months after the conflict began had distant SEER stage disease, while 2 (11.8%) had regional disease. Eight (66.7%) of the 12 patients who presented between 3 and 9 months after the conflict began had localized disease, and 4 (33.3%) had distant SEER stage disease. Sixteen (76.2%) of 22 patients who presented 9–12 months after the conflict began (excluding one patient with non-cancer diagnosis) presented with distant SEER stage disease and 4 (19%) had localized disease (Figure 1).

Paediatric intensive care unit admission

Fourteen (82%) of the patients who presented to KHCC within the first 3 months of the conflict were treated as outpatients, 3 (18%) were admitted to the hospital and none required paediatric intensive care unit (PICU) admission. For those who presented during 3–9 months after the conflict began, 11 (92%) were treated as outpatients, 1 (8%) was admitted to the hospital, and no PICU admission was needed. The situation was worse for those who presented 9–12 months after the conflict began: 8 (36%) required hospitalization and 7 (32%) required PICU admission. Total PICU admissions were 13.7% of cases.

Nutritional and psychological status of the patients

Fourteen (27.5%) of the patients were underweight (Table 1). The majority (76.4%) of those who presented during the early months of the conflict had adequate nutrition (5th–95th percentile). The nutritional status deteriorated as the conflict progressed: 8 (36.4%) of the children who presented during 9–12 months after the conflict began were underweight. Twenty-six (51%) of the patients scored ≥6 on the distress thermometer scale, indicating significant emotional and psychological burden (7).

Status of patients during follow-up

At the last follow-up during this study period, 36 (70.6%) patients were still receiving anticancer treatment, 15 (29.4%) had completed their therapy, 35 (68.6%) were in complete remission, and 16 (31.4%) had persistent disease (Table 2). Two patients died at 4–6 months after initial diagnosis and 9–61 days from presentation at KHCC. Both patients died of progressive disease, one of them had Ewing sarcoma, disseminated fungal infection and gram-negative sepsis and the other had ependymoma.

Table 2. Clinical characteristics and treatment outcomes of patients (N = 51)

Characteristic	Number (%)
Diagnosis type	
New cancer diagnosis	13 (25.5)
Pre-existing cancer	32 (62.7)
Relapsed/refractory disease	6 (11.8)
Disease status at presentation at the KHCC	
Remission	28 (55)
Relapse/refractory/progressive requiring therapy	23 (45)
SEER stage	
In situ	0 (0)
Localized	12 (24)
Regional	3 (6)
Distant*	35 (70)
Diagnosis category	
Histiocytic disorders	4 (7.8)
Acute leukaemia	20 (39
Solid tumours	11 (21.6)
Retinoblastoma	3 (5.9)
Central nervous system tumours	7 (13.7)
Lymphomas	5 (9.8)
Other (Non-cancer)†	1 (2)
Type of therapy‡	
Steroids	9 (17.6)
Chemotherapy	32 (62.7)
Radiotherapy	3 (5.8)
Surgery	13 (25.5)
No therapy	11 (21.6)
Therapy status at KHCC	
On therapy	36 (70.6)
Off therapy	15 (29.4)
Disease status at last follow-up	
In remission	35 (68.6)
Not in remission	13 (29.4)
Patient status at last follow-up	
Alive	49 (96)
Dead	2 (4)

Non-cancer case is excluded from SEER staging

†These data include patients who received more than one type of treatment or a combination of treatments

‡Leukaemia is included in distant SEER staging

KHCC = King Hussein Cancer Center; SEER = surveillance, epidemiology and end results

Discussion

This study highlights the alarming situation of Gaza children with cancer who received treatment at KHCC within one year from the onset of the October 2023 war in Gaza. There were significant delays in diagnosis, treatment, referral and presentation at KHCC and these impacted the treatment outcomes (8,4,9), as already reported for other conflict zones (10). Most patients (70%) presented with metastasis and a notable proportion (11.8%) presented with relapsed or refractory disease, reflecting the impact of disruption on care. Many of them were critically ill at presentation to KHCC and required PICU admission. Similar patterns have been reported among Syrian refugees (11).

Figure 1. **SEER staging characteristics of paediatric cancer patients at time of presentation to KHCC**

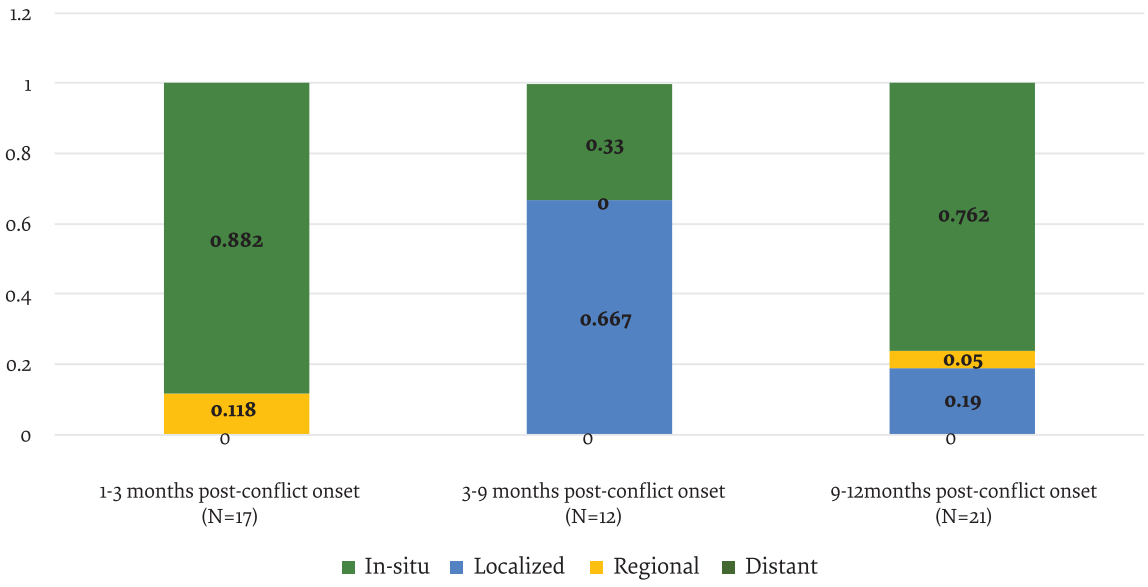
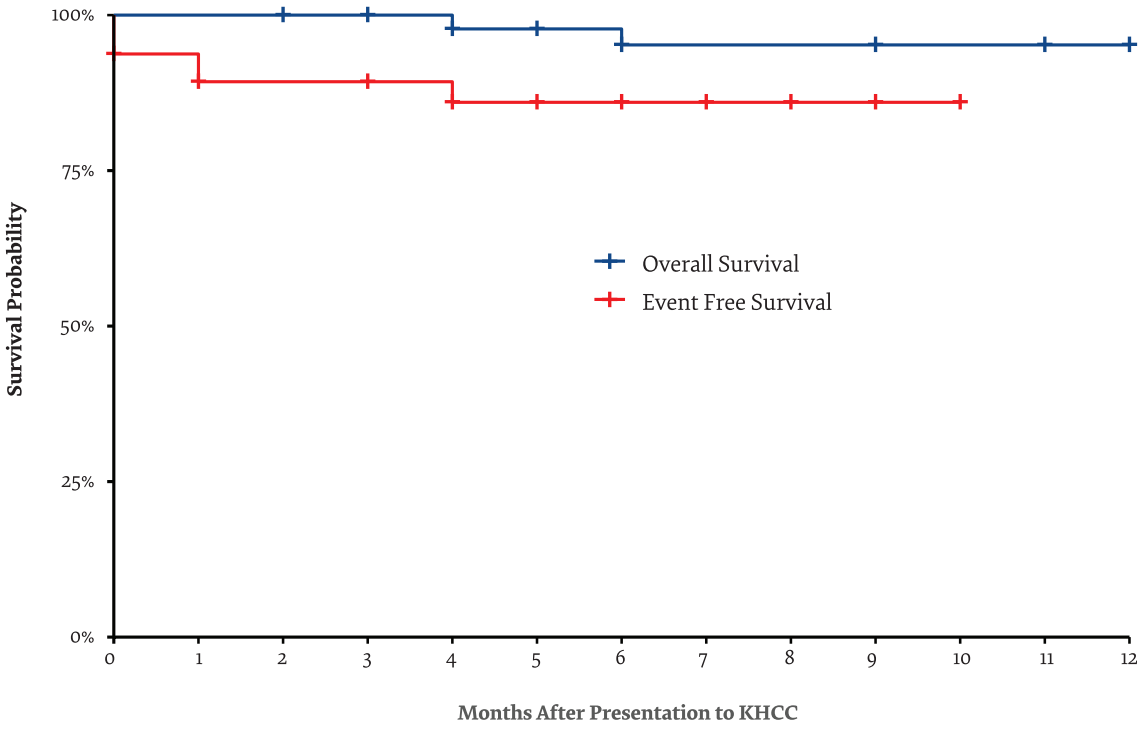


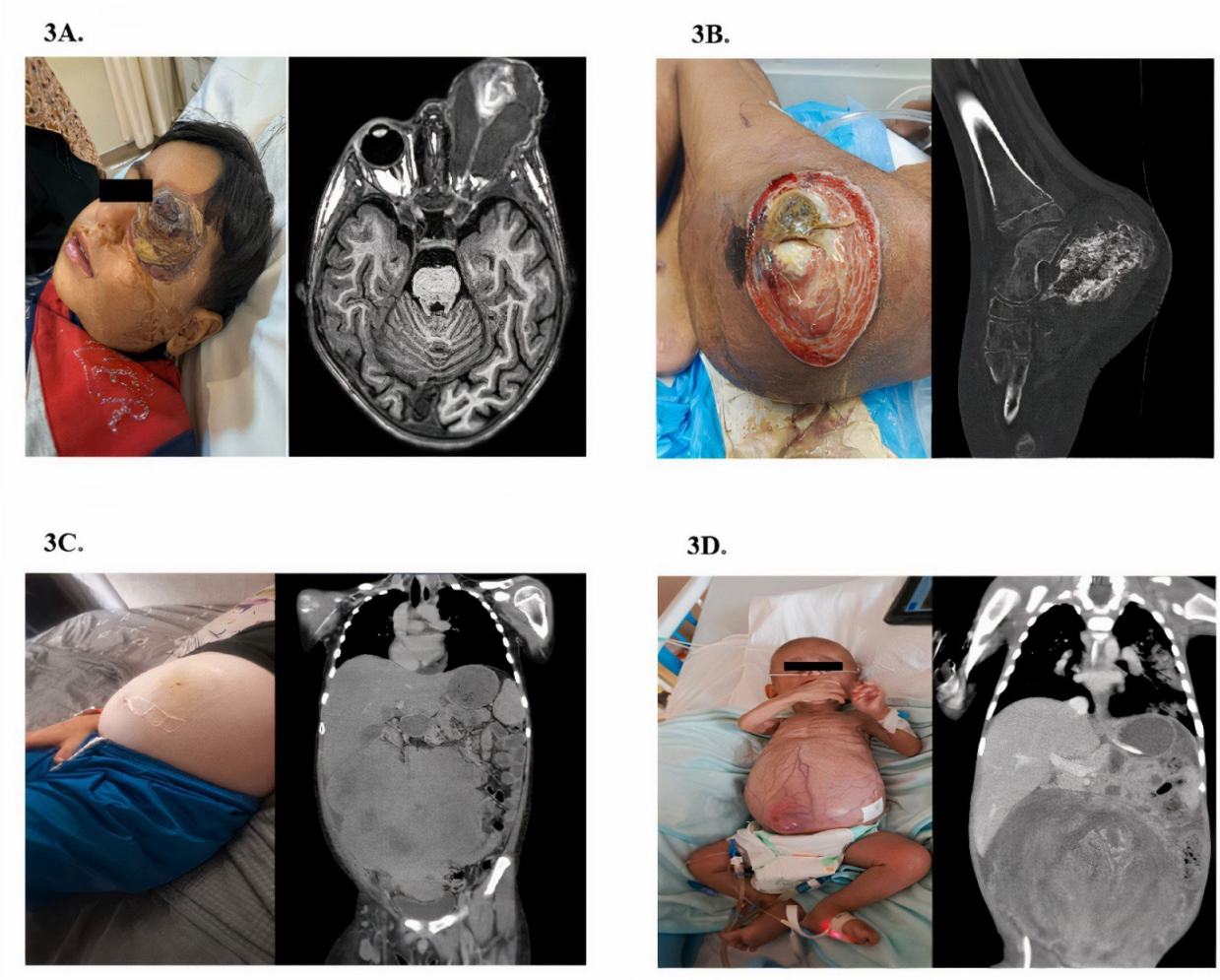
Figure 2. **Survival rates of displaced paediatric cancer patients at KHCC**



Movement restrictions and border closures caused delays in the evacuation of critical ill patients in conflict zones, indicating the need for protected humanitarian corridors to ensure timely medical evacuations during conflicts *(11)*. However, partnerships between KHCC, St Jude Children's Research Hospital and international organizations made the evacuations possible, highlighting the importance of collaborations on health care in conflict zones.

We observed serious emotional toll on the children and their families due to the illness and the impact of the conflict. The ≥6 score on the distress thermometer scale

Figure 3. Clinical features of 4 advanced cases presented at KHCC: (a) left eye retinoblastoma; (b) metastatic Ewing sarcoma with infected pressure ulcers, (c) Burkitt lymphoma, and (d) rapidly progressing rhabdomyosarcoma and severe malnutrition



observed among 48% of the patients is an indication of severe psychological distress (7). Their nutritional health had deteriorated, reflecting the worsening humanitarian condition and food insecurity in Gaza. Among patients who presented to KHCC 9 months into the conflict, 36.4% were underweight. The advanced disease condition, mortality and the need for PICU admission underscore the urgent need for coordinated action to meet the health care needs of vulnerable patients still in Gaza to prevent further loss of lives.

Limitations of the study

This was a retrospective study that relied on pre-existing data, which may not have had the necessary comprehensive clinical and psychosocial details. As a single-centre study, the findings may not be generalizable to other settings. The inclusion of only patients who had travel approvals may have introduced some selection bias, as these patients may differ from others in disease severity, socioeconomic status or access to resources. The psychosocial assessments may not have fully captured the challenges faced by families in the conflict zone, and the short follow-up period places limitations on the long-term outcomes. The absence of a control group did not give room for comparisons.

This study highlights the need for further research on the unique challenges faced by paediatric oncology patients in conflict zones and for prospective studies with larger, more diverse populations to enhance the generalizability of the findings and provide deeper insights into the long-term treatment outcomes. There is also a need for comparative studies that evaluate different models of care delivery, including telemedicine and community-based care, to provide evidence for more effective and scalable solutions.

Conclusions

Conflicts have severe impact on paediatric cancer care. There is therefore a need for innovative strategies to improve access to timely diagnosis, treatment and care for displaced populations in conflict zones such as Gaza, including the development of streamlined referral systems through cross-border collaborations.

Acknowledgements

We would like to acknowledge Dr Iyad Sultan at KHCC for helping with the Kaplan-Meier survival curve and Angela Mcarthur at St Jude Children's Research Hospital for reviewing and editing the manuscript.

Funding: None.

Conflict of interest: None declared.

Redonner santé et espoir aux enfants déplacés de Gaza atteints d'une maladie maligne dans un centre de cancérologie en Jordanie

Résumé

Contexte : Les enfants de Gaza atteints de cancer ont subi des retards critiques dans le diagnostic et le traitement de la maladie en raison du conflit, ce qui a entraîné une prise en charge tardive.

Objectif : Évaluer l'impact des perturbations sur les résultats des traitements des enfants originaires de Gaza atteints de cancer pris en charge au Centre du cancer Roi Hussein à Amman (Jordanie).

Méthodes : Nous avons recueilli et analysé des données relatives aux enfants de Gaza âgés de 0 à 21 ans, atteints de maladies malignes, qui ont été évacués et ont reçu un traitement au Centre du cancer Roi Hussein entre octobre 2023 et octobre 2024. Nous avons utilisé les estimations de survie de Kaplan-Meier pour analyser leur taux de survie global.

Résultats : Cinquante et un enfants gazaouis ont reçu un traitement contre le cancer dans le centre pendant la période couverte par l'étude ; leur âge médian était de 8,2 ans et 66,7 % des patients étaient des garçons. Parmi ces cas, 25,5 % étaient de nouveaux diagnostics, 11,8 % correspondaient à des rechutes et 62,7 % avaient déjà été traités à Gaza. De plus, 39,2 % des enfants étaient atteints de leucémie et 21,6 % de tumeurs solides. L'orientation des patients avait été retardée de trois à quatre mois et au moment de leur prise en charge, 51 % présentaient une détresse psychologique et 27,5 % un déficit pondéral. Après quatre mois de suivi, 96 % ont survécu.

Conclusion : La plupart des enfants ont subi des retards en matière de diagnostic, d'orientation et de prise en charge, ce qui a affecté les résultats des traitements. Des stratégies bien coordonnées, telles que des systèmes rationalisés d'orientation-recours, des collaborations transfrontalières et des évacuations médicales rapides via des couloirs humanitaires protégés, sont cruciales pour fournir les soins vitaux aux patients pédiatriques atteints de cancer à Gaza et dans d'autres zones de conflit.

استعادة الصحة والأمل للأطفال النازحين من غزة المصابين بالأمراض الخبيثة في مركز للسرطان في الأردن

رود ريحاني، سيما جحا، زينة سلمان، شروق عامر، إبراهيم القدومي، كارلوس رودريجيز جالينديو، عاصم منصور

الخلاصة

الخلفية: عانى أطفال غزة المصابون بالسرطان تأخيرات حرجة في التشخيص والعلاج بسبب النزاع الدائر، الأمر الذي تسبب في تدهور حالتهم المرضية إلى مراحل متأخرة.

الأهداف: هدفت هذه الدراسة الى تقييم أثر انقطاعات العلاج بسبب النزاع على نتائج علاج أطفال غزة المصابين بالسرطان الذين عولجوا في مركز الحسين للسرطان في عمان بالأردن.

طرق البحث: لقد جمعنا وحللنا بيانات من أطفال غزة الذين تتراوح أعمارهم بين يوم واحد و21 عامًا المصابين بمرض خبيث، الذين جرى إجلاؤهم وتلقوا العلاج في مركز الحسين للسرطان في الفترة بين أكتوبر/ تشرين الأول 2023 وأكتوبر/ تشرين الأول 2024. واستخدمنا تقديرات كابلان–ماير لحساب البقاء على قيد الحياة لتحليل قدرتهم على النجاة بشكلٍ عام.

النتائج: تلقى واحد وخمسون طفلاً من أطفال غزة علاجًا للسرطان في المركز خلال فترة الدراسة؛ وبلغ متوسط أعمارهم 8.2 سنوات، وبلغت نسبة الذكور 66.7%. وتبين أن 25.5% من الحالات تم تشخيصهم حديثًا، و11.8% كانت حالات انتكاس، و62.7% سبق لهم تلقي العلاج في غزة، في حين شُخِّصت 39.2% من الحالات بسرطان الدم وتبين أن 21.6% من الحالات لديها أورام صلبة. وقد تأخرت إحالتهم لما بين 3 إلى 4 أشهر، وعند وصولهم، أظهر 51% منهم إصابتهم بضائقة نفسية، كما كان 27.5% يعانون نقص الوزن. وبعد 4 أشهر من المتابعة، نجا 96% من الحالات.

الاستنتاجات: عانى معظم الأطفال تأخيرات في التشخيص والإحالة والعلاج، وأثر ذلك على مخرجات العلاج لديهم. وبالمقابل، فإن توفير الرعاية المنقذة للأرواح لمرضى سرطان الأطفال في غزة ومناطق النزاع الأخرى يستلزم بالضرورة استراتيجيات جيدة التنسيق، مثل نُظم الإحالة المبسطة، والتعاون عبر الحدود، والإجلاء الطبي في الوقت المناسب من خلال الممرات الإنسانية المحمية.

References

1. Salman Z, Shbair M, Zeineddin M, Balousha T, Qaddoumi I, Rodriguez-Galindo C. Cancer care for children in the Gaza Strip. Lancet Oncol. 2021;22(12):1667-1668. DOI: 10.1016/S1470-2045(21)00612-0.
2. Mills D, Abushanab S, Elhaloul A, El Nuweiry H, Shbair M, Qaddoumi I, et al. Barriers to care and outcomes of pediatric acute lymphoblastic leukemia treatment in the Gaza Strip. J Ped Hematol/Oncol. 2022;44(1):e123-e6. DOI: 10.1097/MPH.0000000000002340.
3. Rihani R, Jeha S, Nababteh M, Rodriguez-Galindo C, Mansour A, Sultan I. The burden and scope of childhood cancer in displaced patients in Jordan: The King Hussein Cancer Center and Foundation experience. Front Oncol. 2023;13. DOI: 10.3389/fonc.2023.1112788.
4. Nashwan AJ. A Double battle: Fighting cancer in the shadows of conflict in Gaza. Cureus. 2023;15(11):e48371. DOI: 10.7759/cureus.48371.
5. World Health Organization. WHO in Occupied Palestinian Territory. Cairo: WHO Regional Office for the Eastern Mediterranean, 2024. https://www.emro.who.int/opt/information-resources/emergency-situation-reports.html.
6. Saab R, Jeha S, Khalifeh H, Zahreddine L, Bayram L, Merabi Z, et al. Displaced children with cancer in Lebanon: A sustained response to an unprecedented crisis. Cancer 2018;124(7):1464-1472. DOI: 10.1002/cncr.31230.
7. Abu-Odah H, Molassiotis A, Liu JYW. A distress thermometer with a cutoff score of ≥6 is the optimal point to identify highly distressed patients with advanced cancer stages in resource-limited countries without palliative care services. Front Oncol. 2023;13:970164. DOI: 10.3389/fonc.2023.970164.
8. Jawad M, Millett C, Sullivan R, Alturki F, Roberts B, Vamos EP. The impact of armed conflict on cancer among civilian populations in low- and middle-income countries: a systematic review. Ecancermedicalscience 2020;14:1039. DOI: 10.3332/ecancer.2020.1039.
9. Tolia M, Kamposioras K, Symvoulakis EK, Mauri D, Skouras P, Schizas D, et al. Cancer patient care during different war times; is the response too slow? ESMO Open. 2022;7(4):100557. DOI: 10.1016/j.esmoop.2022.100557.
10. Kutluk T, Sahin B, Kirazli M, Ahmed F, Aydin S, Yesil Cinkir H, et al. Clinical characteristics and outcomes of cancer cases among Syrian refugees from southern Turkey. JAMA Netw Open 2023;6(5):e2312903. DOI: 10.1001/jamanetworkopen.2023.12903.
11. Spiegel PB, Cheaib JG, Aziz SA, Abrahim O, Woodman M, Khalifa A, et al. Cancer in Syrian refugees in Jordan and Lebanon between 2015 and 2017. Lancet Oncol. 2020;21(5):e280-e91. DOI: 10.1016/S1470-2045(20)30101-7.