Research Paper

Surgical Treatment of Palestinian Patients With Congenital Heart Disease in a Medical Center in Israel: Challenges and Outcome

Eldad Erez a,⁎, Ely Erez b, Julius Golender c, Ibraheem Mafra a, Oz M. Shapira a, Bisher Marzouqa a,d

a Cardiothoracic Surgery Department Hadassah Medical Center, Hebrew University School of Medicine, Jerusalem, Israel
b Technion, Israel Institute of Technology, School of Medicine, Haifa, Israel
c Congenital Heart Institute Hadassah Medical Center, Hebrew University School of Medicine, Jerusalem, Israel
d Cardiothoracic Surgery Department, Alahli Hospital, Hebron, West Bank, Israel

A B S T R A C T

Background: The treatment of congenital heart disease patients in the West Bank and Gaza involves both medical and political challenges. Understanding the difficulties faced in treating the Palestinian population is an important step to improving surgical care, better allocating resources and overcoming the region’s unique problems.

Methods: The Hadassah Medical Center congenital heart disease database over the 2011–2017 period was analyzed. There were 872 operations performed in patients with Israeli health insurance and 207 operations in Palestinian patients. Patient characteristics and surgical outcome were compared between the two groups using standard statistical practices.

Findings: The Society of Thoracic Surgeons Complexity Scores were significantly higher in the Palestinian patients, \( p = 0.003 \) (\( d = 0.27, 95\% \text{ CI, 0.12 to 0.42} \)). Israeli neonates had surgery at an average age of 9.5 ± 7.8 days as compared to Palestinian neonates with an average age of 15.7 ± 8.2 days, \( p < 0.001 \) (\( d = 0.78, 95\% \text{ CI, 0.41 to 1.15} \)), a finding indicative of a possible delay of treatment. Overall in hospital mortality was not significantly different. Late mortality was significantly higher for the Palestinian 5.4% (9/168) compared to Israeli patients 2% (14/698), \( p = 0.015 \) (RR = 2.67, 95% CI, 1.18 to 6.07).

Interpretation: The findings suggest that Palestinian patients receive later treatment and poorer follow-up care than Israeli patients. Despite the political challenges in the region surgical results are excellent and comparable between the two groups. The challenges described are not unique to congenital heart disease and may affect many medical fields. We believe that extensive collaborations between Israeli and Palestinian physicians may be key to improving the Palestinian medical care.

Funding: None.

© 2019 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Over the last decade significant advances have been made in the treatment of congenital heart disease in the western world [1]. Prenatal care, neonatal repair of complex congenital heart defects, advances in postoperative care and continued follow-up into adulthood have contributed to the significant decrease in morbidity and mortality. Unfortunately, treatment of congenital heart disease is a highly specialized and expensive medical specialty [2]. In less privileged regions of the world high costs make congenital heart surgery unattainable for most patients. Furthermore, late diagnosis, associated comorbidities, limited infrastructure and limited resources contribute to the suboptimal outcomes of those who do undergo surgery [3].

Currently, the Palestinian health care system lacks the economic resources and sophisticated infrastructure needed to treat many of the patients with congenital heart disease living in the West Bank and Gaza [4], and as a result many of these patients are treated in medical centers in Israel. This has created a unique situation where for many years patients from a less privileged region have been treated in a developed country’s medical system. The data collected over the years can be used to compare the outcomes and quality of care of the two distinct populations. The objective of this study was to compare patient characteristics and surgical outcomes of patients from the West Bank and patients from Israel treated at Hadassah Medical Center in Jerusalem. This study’s results may further our understanding of the differences between these two patient populations with the hope of improving their surgical care.
2. Methods

2.1. Study Design and Population

We reviewed the records of all patients with congenital heart defects who underwent heart surgery at the Hadassah Medical Center in Jerusalem between January 2011 and December 2017. There were 872 operations in patients with Israeli health insurance and 207 operations in Palestinian patients. Patient data was collected in accordance with the principals of the Society of Thoracic Surgeons’ (STS) database [5]. Our database, established in January 2011, records information about patient demographics, medical diagnoses, surgical complexity scores, postoperative course including ICU stay, ventilation time, complications, hospital stay, clinical and echocardiographic outcome, and postoperative clinic follow-up. This data is reported quarterly to the Society of Thoracic Surgeons as part of our participation in the STS database.

The cost of treatment for Israeli patients was covered by the Israeli national health insurance. This coverage is identical for all ethnic groups: Jewish Israelis, Arab Israelis and the majority of Arabs living in East Jerusalem. The cost of treatment for Palestinian patients was covered by donations, mainly by the French grant ‘A Heart for Peace’ or by the Palestinian Authority. Due to the difficult economic situations in the West Bank and Gaza, Hadassah Medical Center charges these organizations half the cost it charges for Israeli patients. Hadassah Medical Center charges the same price for all types of heart surgeries for all patients, regardless of complexity or hospital length of stay. The cost of treatment did not affect the type of treatment offered to either group of patients.

All the patients were evaluated by our pediatric heart institute team in addition to the referring cardiologists before the optimal treatment plan was presented to every patient’s family. After discharge from the hospital the Palestinian patients were followed by their referring pediatric cardiologist in the West Bank. The Hadassah Medical Center Institutional Review Board approved the study and waived individual patient consent due to the retrospective nature of the study.

2.2. Variables

The primary endpoints of the study were surgical mortality and five-year survival from hospital discharge. Surgical mortality was defined as mortality during the index hospitalization. Mortality status post discharge from the hospital was obtained from the Palestinian Central Bureau of Statistics and the Israeli Population and Immigration Authority. Secondary endpoints included time to surgical treatment as well as pediatric intensive care unit (PICU) and hospital length of stay (all measured in days).

The main study exposure was the patients’ nationalities. Patient characteristics that were accounted for included age, sex, STS complexity scores and single ventricle vs biventricular surgical repair.

Not all Palestinian patients are referred for treatment in Israel and the referral process may create a selection bias in the Palestinian patient population. We believe the main deciding factor is financial and therefore more complex patients are referred for treatment in Israel. Additionally, the rates of induced termination of pregnancy due to congenital heart disease may differ between the Arab and Non-Arab populations potentially contributing to a selection bias. Potential confounding variables may include differences in maternal follow-up during pregnancy, socio-economic status, ethnic origin, presurgical medical surveillance, and time from diagnosis to treatment. Length of gestation and birth weights may also differ between the populations and might confound mortality rates in neonates. According to our data, 95% of Israeli patients had a routine long-term pediatric cardiology follow-up post-surgery as opposed to only about 70% of the Palestinian patients. This disparity may affect long-term survival.

The Society of Thoracic Surgeon’s Surgical Complexity Stratification is a method of analysis in which the data are divided into relatively homogeneous groups (strata). The data is analyzed and reported within each stratum. The STS method uses 5 categories and serves as the main complexity adjustment tool for the STS Congenital Heart Surgery Database. Each procedure received a score ranging from 0.1 to 5.0, based on the estimated mortality. The procedures were then distributed by the growing risk and grouped into the 5 categories.

The Mortality Categories are an empirically derived methodology of complexity stratification based on statistical estimation of the risk of mortality from an analysis of objective data from the STS Congenital Heart Surgery Database and the European Congenital Heart Surgery Database [6].

2.3. Data Analysis

The association of the patients’ nationalities with surgical complexity stratification and mortality was first studied by univariate analysis. Chi-squared test or Fisher’s exact test were used to compare categorical variables and Relative Risk (RR) was used to assess the effect size. Comparison of quantitative and ordinal variables between two independent
groups was made using the Student’s t test or the Mann–Whitney U test as appropriate and standardized mean difference (a.k.a. Cohen’s d) was used to assess the effect size.

As discussed above, selectivity bias is manifested in an uneven distribution of the complexity score among Israeli and Palestinian patients. We studied surgical mortality in a binary outcome regression setting by the logistic model, which controls for the confounding effect of complexity scores; adjusted odds ratio was used to assess the effect size. The co-variates included in this regression analysis were sex, STS complexity scores; adjusted odds ratio was used to assess the effect size. The dependent variable was surgical mortality.

Five-year survival was first analyzed by a Kaplan–Meier estimator of the survival function. This analysis did not include the cases of surgical mortality; for patients who underwent multiple surgeries follow up time was calculated from the first surgery. Survival spans of recent patients with follow-up times shorter than 5 years were right-censored at the follow-up time available. On the other end, survival spans of earlier patients, with follow-up period longer than 5 years, were limited to 5 years. The total number of patients included in the Kaplan–Meier estimator was 694 Israelis and 169 Palestinians. Then, a proportional hazards Cox model was estimated to adjust for possible confounding effects by the logistic model, which controls for the confounding effect of com-

Mortality rates are presented in Table 2. Overall surgical mortality was 2.2% for the Israeli patients and 3.9% for the Palestinian patients, p = 0.163 (RR = 1.77, 95% CI, 0.79 to 4.0). Surgical mortality within the population of single ventricle patients was 4.6% for the Israeli patients compared to 11.3% for the Palestinian patients, p = 0.077 (RR = 2.45, 95% CI, 0.89 to 6.74). In the population of patients with biventricular repair, the surgical mortality was 1.6% for the Israeli patients compared to 1.3% for the Palestinian patients, p = 0.8 (RR = 0.83, 95% CI, 0.19 to 3.68). A binary outcome logistic regression model, that assessed surgical log of PICU hospitalization length which we used to account for recovery time and post-surgical complications.

22 Israeli patients and 5 Palestinian patients were excluded from the total hospitalization length analysis due to missing data. Similarly, 32 Israeli patients and 8 Palestinian patients were excluded due to missing data on their PICU hospitalization length. We assume that this data was missing at random and therefore does not create a selection bias. Statistical analysis was performed using SPSS 21. A p value of less than 0.05 was considered statistically significant.

3. Results

Demographics and clinical characteristics of the patient population are presented in Table 1. The mean STS complexity scores were significantly higher in the Palestinian patient population, p < 0.001. As aforementioned, the patient’s nationality supposedly confounds for a variety of factors, including socio-economic status, ethnic and cultural differences, and pre- and post-surgery medical attention, to mention the prominent ones. To determine the importance of some of these factors, we further divided the Israeli patients by ethnic origin into Israeli Non-Arab (524 patients) and Israeli Arab (348 patients), to be compared with the Palestinians (207 patients). The Israeli Arab population is ethnically and culturally similar to the Palestinian population.

The distribution of STS complexity scores for the three population groups is presented in Fig. 1. Mean complexity score of the Palestinian patient population was significantly higher than the means of Non-Arab and Arab Israeli patient populations (p < 0.001 and p = 0.006 respectively). Notably, the difference between mean values of the complexity score of Non-Arab and Arab Israeli populations was not statistically significant (p = 0.32).

A comparison of the average complexity score in patients with single ventricle anatomy did not show any significant difference between the Israeli and Palestinian patient populations, p = 0.74. However, there was a higher percentage of patients with single ventricle anatomy treated in the Palestinian group although the difference didn’t reach statistical significance (p = 0.067, see Table 1).

Abbreviations: STS, Society of Thoracic Surgeons; pt, patient.
mortality while controlling for the STS complexity disparity, yielded \( p = 0.346 \) (adjusted OR = 1.52, 95% CI, 0.64 to 3.63) between the Palestinian and Israeli patient populations. The adjusted odds ratios of the predictors in the surgical mortality model are presented in Table 3.

The prolonged Palestinian–Israeli conflict has had significant deleterious effects on the Palestinian medical care [8]. As a result of the unstable situation, Palestinian health care has been provided by several different entities: The Palestinian Authority health care system, the UN Relief and Work Agency and the private medical sector. Current health services, specifically tertiary health care providers, are limited and unable to satisfy the needs of the large West Bank and Gaza populations [9]. This situation has forced the Palestinian Authority to refer patients with complex health conditions for treatment in Israel, Egypt and Jordan.

The Israeli health care system has been heavily involved, for many years, in the treatment of Palestinian patients and training of Palestinian physicians in Israeli hospitals [10,11]. This involvement has continued despite significant fluctuations in the relationship between the Palestinian and Israeli governments. Both sides believe that this medical cooperation may serve as a bridge for rebuilding trust in the future [12].

The current medical team in the West Bank and Gaza providing treatment for patients with congenital heart disease includes several perinatology physicians and pediatric cardiologists. About a third of these physicians were trained in Israeli medical centers. Yet prenatal care is still very limited in the West Bank and Gaza compared to Israel. There are two medical centers in the West Bank that perform congenital heart surgery. The larger of the two is Al Makassed Islamic Charitable Society Hospital in east Jerusalem, operating since 2013 with a pediatric cardiothoracic department and a Palestinian medical team. The second center is located in the city of Ramallah and until recently was operated mainly by international medical mission teams. Previous data has shown that the work performed by such teams appears to be beneficial only when no other option is available. Worse results and a lack of cost-effectiveness compared to other platforms have curtailed their role [13]. In addition, some surgical mission trips have been used as an educational opportunity for the visiting staff rather than an opportunity to advance local medical treatment [14]. In order to alleviate these problems the American Academy of Pediatrics has published guidelines for short surgical mission trips [15]. Long term success of these visits can be achieved only when linked to a training program of local surgeons and support staff which will enable them to develop a local, independently functioning, surgical center. We believe that, of the currently available options for pediatric congenital heart surgery

### Table 2

Mortality rates by patient's nationality.

| Mortality                          | Israeli pt | Palestinian pt | p value | Relative Risk (95% CI) |
|-----------------------------------|------------|----------------|---------|------------------------|
| Total surgical mortality          | 2.2% (19/872) | 3.8% (8/207)   | 0.163   | 1.77 (0.79 to 4.0)     |
| Single ventricle surgical mortality| 4.6% (8/173)  | 11.3% (6/53)   | 0.077   | 2.45 (0.89 to 6.74)    |
| Biventricular surgical mortality  | 1.6% (11/699) | 1.3% (2/154)   | 0.8     | 0.83 (0.19 to 3.68)    |
| Mortality post-release            | 2% (14/694)  | 4.7% (8/169)   | 0.055   | 2.28 (0.97 to 5.36)    |

Abbreviations: CI, confidence interval; pt, patient.

### Table 3

Estimates of logistic regression for binary outcome model of surgical mortality.

| Nationality     | No. of survivors | No. of non-survivors | Adjusted OR (95% CI) | p value |
|-----------------|------------------|----------------------|----------------------|---------|
| Israeli         | 853/872 (97.8%)  | 19/872 (2.2%)        | 1.0 [ref]            |         |
| Palestinian     | 199/207 (96.1%)  | 8/207 (3.9%)         | 1.52 (0.64 to 3.63) | 0.346   |
| STS complexity  |                  |                      |                      |         |
| score 1         | 349/351 (99.4%)  | 2/351 (0.6%)         | 1.0 [ref]            |         |
| 2               | 360/362 (95.4%)  | 2/362 (0.6%)         | 0.94 (0.13 to 6.69) | 0.946   |
| 3               | 123/127 (96.9%)  | 4/127 (3.1%)         | 5.42 (0.98 to 30.05)| 0.053   |
| 4               | 186/198 (93.9%)  | 12/198 (6.1%)        | 10.61 (2.34 to 48.22)| 0.002   |
| 5               | 34/41 (82.9%)    | 7/41 (17.1%)         | 34.99 (6.98 to 175.42)| <0.001  |
| Constant        |                  |                      | 0.005                | <0.001  |

Abbreviations: OR, odds ratio; CI, confidence interval; STS, Society of Thoracic Surgeons.

Notes: The model also included patient's sex and natural logarithm of age (days) at surgery – omitted because of low statistical significance. The Hosmer and Lemeshow test for goodness of fit yielded \( p = 0.87 \).
in the West Bank and Gaza, short surgical mission trips present the worst quality of care for Palestinian patients.

One of the quality measures for congenital and pediatric cardiac surgery is participation in a national or international database [16]. This has been shown to improve patient care in low income regions as well [17]. Participation is usually limited to the developed world due to the financial resources needed to participate in such a database. Furthermore, health research in the West Bank and Gaza is poorly prioritized and does not focus on the diseases prevalent in the region [18].

In recent years the World Society for Pediatric and Congenital Heart Surgery has started an international database for the improvement of care across the world [19]. However, in low income regions every financial resource available is used for direct patient care. Until joining the database will be free of charge for low income regions it will be impossible to achieve significant participation. The Palestinian medical system has proven its willingness to create registries to improve care but lacks the funding to do so [20].

Utilizing our patient data, we were able to identify several statistically significant differences between Palestinian and Israeli patient populations, many of which result from the complex situation in the region. The significantly higher surgical complexity scores of congenital heart disease among the Palestinian patients and the increased number of patients with a single ventricle anatomy treated at our institution compared to the Israeli patients may be the result of several factors. Our findings indicate that the disparity in the complexity score is associated with the Palestinian nationality rather than Arab ethnicity. By extension, this supports our assessment that the limited resources and infrastructure have led the Palestinian health care system to treat most of their patients with lower surgical complexity scores within their own system either through medical mission groups or at Al Makassed Islamic Hospital in east Jerusalem. Some of the more complex patients are therefore referred to medical centers in Israel for treatment. Additionally, the high consanguinity rate among Palestinians (about 40%) has been known to contribute to the increased prevalence of complex birth

| Table 4 | Hospitalization length and neonate age by patient's nationality. |
|---------|---------------------------------------------------------------|

|                | Israeli pt | Palestinian pt | p value | Cohen’s d (95% CI) |
|----------------|------------|----------------|---------|--------------------|
| Mean hospital stay (days) | 11.1 (SD 11.4) | 11.4 (SD 10.5) | 0.7 | 0.028 (−0.13 to 0.18) |
| Mean PICU stay (days) | 6.29 (SD 10.8) | 5.6 (SD 7.7) | 0.65 | −0.06 (−0.22 to 0.09) |
| Mean age of neonates at first surgery (days) | 9.5 (SD 7.8) | 15.7 (SD 8.2) | <0.001 | 0.78 (0.41 to 1.15) |

Abbreviations: PICU, pediatric intensive care unit; SD, standard deviation; CI, confidence interval.

Fig. 2. Post discharge Kaplan–Meier survival analysis stratified by nationality. Censored patients are indicated on the curves. Time axis is right censored at 60 months.
The model also included patient’s sex and hospital stay lower follow-up rate is another problem caused by the limited resources cardiology follow-up among the Palestinian patients. Presumably the associated with the lower percentage of routine long-term pediatric surgical complexity, age and PICU stay. The higher late mortality may be as statistically signi ş in the region [23,24]. While the conflict may indeed be a major factor, we as physicians have very little influence on the political situation. It is our duty to find any way possible to cooperate and improve the care the Palestinian patients receive even under the current circumstances.

This study has helped us better understand the challenges specific to surgical treatment of Palestinian patients with congenital heart disease. As a result of our findings we have strengthened our collaboration with the pediatric cardiologists in both the West Bank and Gaza in order to shorten referral times and are working to provide a better long term follow-up solution for Palestinian patients with single ventricle anatomy and high surgical complexity scores. Recently, a Palestinian surgeon trained at our department has begun a small pediatric surgical program in Ramallah supported by surgical mission groups and our hospital.

Some of the limitations of this study include the lack of data on potential confounders such as prenatal care and induced abortion rates due to congenital heart disease, which likely differ between the populations. Additionally, we lacked the data to accurately estimate the time delay between diagnosis and treatment of non-neonatal patients, which may influence surgical outcomes. The number of patients included in this study may be too small to capture some clinically relevant associations due to lack of statistical power.

This study has illustrated several problems the Palestinian medical system is facing with treatment of pediatric and congenital heart surgery. The challenges described are not unique to congenital heart disease and may affect many other medical fields in the Palestinian medical system. Some people believe that these problems are all the result of the ongoing political conflict in the region [23,24]. While the conflict may indeed be a major factor, we as physicians have very little influence on the political situation. It is our duty to find any way possible to cooperate and improve the care the Palestinian patients receive even under the current circumstances.

This study has helped us better understand the challenges specific to surgical treatment of Palestinian patients with congenital heart disease. As a result of our findings we have strengthened our collaboration with the pediatric cardiologists in both the West Bank and Gaza in order to shorten referral times and are working to provide a better long term follow-up solution for Palestinian patients with single ventricle anatomy and high surgical complexity scores.

Authors’ Contributions

EE: Literature search, study design, wrote the manuscript
EE: Statistical work, data analysis and interpretation, editing, figures
JC: Data collection, manuscript revision, study design
IM: Data collection, follow-up
OMS: Manuscript revision
BM: Data collection from Palestinian central bureau of statistics.

Declaration of Interests

We declare no competing interests.

Funding Sources

There was no funding for this study.

### Table 5

| Nationality | No. of survivors | No. of non-survivors | Hazard ratio (95% CI) | p value |
|-------------|------------------|----------------------|-----------------------|---------|
| Israeli 1   | 680/694 (98%)    | 14/694 (2%)          | 1.0 [ref.]            | 0.061   |
| Palestinian 2 | 161/169 (95.3)  | 8/169 (4.7%)         | 2.52 (0.95 to 6.66)   | 0.062   |
| STS complexity score 3 | 200/202 (99.3%) | 2/202 (0.7%)         | 1.05 (0.15 to 7.63)   | 0.059   |
| 1 4 | 103/106 (97.2%)  | 3/106 (2.8%)         | 5.59 (0.88 to 35.71)  | 0.069   |
| 2 5 | 134/145 (92.4%)  | 11/145 (7.6%)        | 9.06 (1.72 to 47.8)   | 0.009   |
| PICU hospitalization length (days) 6 | 22/26 (84.6%) | 4/26 (15.4%) | 31.67 (4.27 to 234.73) | 0.001 |
| Age at surgery (days) 7 | 5.0 (SD 7.5) | 23.9 (SD 29.8) | 1.04 (1.02 to 1.05) | <0.001 |
| 1 8 | 1751 (SD 3370)   | 1011 (SD 1867)       | 1.25 (1.01 to 1.56)   | 0.041   |

Abbreviations: HR, hazard ratio; CI, confidence interval; STS, Society of Thoracic Surgeons; PICU, pediatric intensive care unit; SD, standard deviation.

Notes: The model also included patient’s sex and hospital stay omitted because of low statistical significance.

- Natural log of continuous variables was used in the regression.

- Mean and standard deviation reported for continuous variables.

### Defects

Congenital heart surgery in less privileged regions of the world has been linked to delay of care [3]. Ascertainin if there is a delay in treatment of Palestinian patients has proven challenging, mainly since we don’t have the exact date of diagnosis for the entire patient cohort.

Since similar conditions are shared by all patients of the Palestinian healthcare system, we may extrapolate that these factors may cause a delay in treating older patients as well.

Given our results showing that the Palestinian patients had a significantly higher surgical complexity score and arrived for surgery with a significant time delay, we expected their outcome to be significantly worse than that of the Israeli patients. However, the Palestinian patients’ overall mortality was not significantly different than that of the Israeli patients. In the single ventricle physiology subgroup of patients, the mortality of the Palestinian group was higher than the mortality of the Israeli group, yet this difference did not reach statistical significance (p = 0.067). Additional data may be needed to substantiate the robustness of this finding. Further analysis may be necessary to assess the difference in this subgroup. Surprisingly, there was no significant difference in the ICU or hospital length of stay between the two groups.

During this study we found that late mortality was higher for Palestinian patients than for Israeli patients. This finding was not found to be statistically significant in the regression analysis that controlled for surgical complexity, age and PICU stay. The higher late mortality may be associated with the lower percentage of routine long-term pediatric cardiology follow-up among the Palestinian patients. Presumably the lower follow-up rate is another problem caused by the limited resources in the West Bank and Gaza.

In light of these findings we added a Palestinian pediatric cardiologist to our team which has enabled us to create outreach clinics in the West Bank to shorten referral times for surgical treatment. He has also established a postoperative follow-up clinic for Palestinian patients, while we work to provide a better long-term follow-up solution for Palestinian patients with single ventricle anatomy and high surgical complexity scores.
References

[1] Jacobs JP, Mayer JE, Pasquali SK, et al. The Society of Thoracic Surgeons Congenital Heart Surgery Database: 2018 update on outcomes and quality. Ann Thorac Surg 2018. https://doi.org/10.1016/j.athoracsur.2018.01.001.

[2] Faroqui D, Nasr VC, DiNardo JD. Overall hospital cost estimates in children with congenital heart disease: analysis of the 2012 kid's inpatient database. Pediatr Cardiol 2016. https://doi.org/10.1007/s00246-015-1235-0.

[3] Saxena A. Congenital cardiac surgery in the less privileged regions of the world. Expert Rev Cardiovasc Ther 2009;7(12):1621–9. https://doi.org/10.1586/erc.09.141 (Review).

[4] WHO. Country cooperation strategy for WHO and the occupied Palestinian territory 2017–2020. http://apps.who.int/iris/bitstream/handle/10665/259862/WHO-EM-PME-008-E-eng.pdf;jsessionid=f4E1DA42A4CA56137CE9871E9F1FBB?sequence=1.

[5] Jacobs JP, Shahian DM, D’Agostino RS, et al. The Society of Thoracic Surgeons National Database 2017 annual report. Ann Thorac Surg 2017. https://doi.org/10.1016/j.athoracsur.2017.10.014.

[6] O’Brien SM, Clarke DR, Jacobs JP, et al. An empirically based tool for analyzing mortality associated with congenital heart surgery. J Thorac Cardiovasc Surg 2009. https://doi.org/10.1016/j.jtcs.2009.03.071.

[7] Nguyen N, Leon-Wyss J, Iyer KS, et al. Paediatric cardiac surgery in low-income and middle-income countries: a continuing challenge. Arch Dis Child 2015. https://doi.org/10.1136/archdischild-2015-308173.

[8] Keelan E. Medical care in Palestine: working in a conflict zone. Ulster Med J 2016;85(1):3–7.

[9] Gacaman R, Abdul-Rahim HF, Wick L. Health sector reform in the Occupied Palestinian Territories (OPT): targeting the forest or the trees? Health Policy Plan 2003. https://doi.org/10.1093/heapol/18.1.59.

[10] Enzi T, Sasso T, Houri S, Berlovitz Y, Tamir A. Save a Child’s Heart project in Israel. Lancet 2014. https://doi.org/10.1016/S0140-6736(14)61984-X.

[11] Cohen AY, Tamir A, Houri S, et al. Save a child’s heart: we can and we should. Ann Thorac Surg 2001. https://doi.org/10.1016/S0003-4975(00)02243-8.

[12] Skinner H, Abdeen Z, Abdeen H, et al. Promoting Arab and Israeli cooperation: peacebuilding through health initiatives. Lancet 2005. https://doi.org/10.1016/S0140-6736(05)74817-0.

[13] Shrim MG, Sleemi A, Ravilla TD. Charitable platforms in global surgery: a systematic review of their effectiveness, cost-effectiveness, sustainability, and role training. World J Surg 2015. https://doi.org/10.1007/s00268-014-2516-0.

[14] Gishen K, Thaller SR. Surgical mission trips as an educational opportunity for medical students. J Craniofac Surg 2015. https://doi.org/10.1097/SCS.0000000000001095.

[15] Butler M, Drum E, Evans FM, et al. Guidelines and checklists for short-term missions in global pediatric surgery: recommendations from the American Academy of Pediatrics Delivery of Surgical Care Global Health Subcommittee, American Pediatric Surgical Association Global Pediatric Surgery C. J Pediatr Surg 2018. https://doi.org/10.1016/j.jpedsurg.2017.11.037.

[16] Jacobs JP, Jacobs ML, Austin EH, et al. Quality measures for congenital and pediatric cardiac surgery. World J Pediatr Congenit Heart Surg 2012. https://doi.org/10.1177/215013511142732.

[17] Balachandran R, Kappanayil M, Sen AC, et al. Impact of the International Quality Improvement Collaborative on outcomes after congenital heart surgery: a single center experience in a developing economy. Ann Card Anaesth 2015. https://doi.org/10.4103/0971-9794.148322.

[18] Hassan S, Villanes A, Laine K, et al. Building a research registry for studying birth complications and outcomes in six Palestinian governmental hospitals. BMC Pregnancy Childbirth 2017. https://doi.org/10.1186/s12884-017-1296-6.

[19] Stavisky M, Robinson R, Sade MY, et al. Elevated birth prevalence of conotruncal heart defects in a population with high consanguinity rate. Cardiol Young 2017. https://doi.org/10.1017/S1047951116000202.

[20] Jin SC, Homsy J, Zaidi S, et al. Contribution of rare inherited and de novo variants in 2,871 congenital heart disease probands. Nat Genet 2017. https://doi.org/10.1038/ng.3970.

[21] Stavisky M, Robinson R, Sade MY, et al. Elevated birth prevalence of conotruncal heart defects in a population with high consanguinity rate. Cardiol Young 2017. https://doi.org/10.1017/S1047951116000202.

[22] Jin SC, Homsy J, Zaidi S, et al. Contribution of rare inherited and de novo variants in 2,871 congenital heart disease probands. Nat Genet 2017. https://doi.org/10.1038/ng.3970.

[23] Giacaman R, Khatib R, Shabaneh L, et al. Health status and health services in the occupied Palestinian territories. Lancet 2009. https://doi.org/10.1016/S0140-6736(09)60107-0.

[24] McNeely C, Barber BK, Spelling C, et al. Human insecurity, chronic economic constraints and health in the occupied Palestinian territory. Glob Public Health 2014. https://doi.org/10.1080/17441692.2014.903427.