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EMPIRICAL RESEARCH QUANTITATIVE

Postponement of elective cardiac surgery: A prospective observational analysis of anxiety, depression, social support and clinical complications

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Abstract

Aims: To investigate patients' psychological reactions to postponement of elective cardiac surgery, and whether postponement was associated with increased complications post-operative and while waiting.

Design: A single-centre observational prospective cohort study.

Methods: All adult patients referred for elective cardiac surgery during the study period were considered for inclusion. Psychological data were collected using a survey distributed to patients prior to surgery and at 6 months post-operative. Clinical data were obtained from patient records.

Results: A total of 83 postponed and 132 non-postponed patients were included. Postponed patients displayed more avoidance behaviour, but only immediately before surgery. Postponed patients maintained their satisfaction with perceived social support, whereas non-postponed patients became more dissatisfied over time. Waiting 0–14 days was associated with increased symptoms of depression before surgery compared to non-postponed patients or those waiting more than 14 days. Surgical complications were the same in both groups. No patients experienced aggravation of their disease leading to urgent or emergent surgery while waiting for surgery. Hospital-related reasons were the most common cause for postponement of surgery.

Conclusion: Postponement of selected patients is not associated with increased risk of psychological distress or complications related to the patient's disease.

Reporting Method: Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).

Implications for Patient Care: Pre- and post-psychological interventions may be relevant to consider in relation to elective cardiac surgery as it has been shown to positively affect outcome. Organisational/hospital-related reasons are still very common causes for postponement of elective surgeries, and hospital administrations should focus upon eliminating/decreasing this.

Public Contribution: Questionnaires filled by patients were used to understand an association between postponement of cardiac surgery and psychological distress.

KEYWORDS
anxiety, cardiac surgery, depression, waiting list

1 | INTRODUCTION

Waiting for planned cardiac surgery may cause uncertainty, psychological distress, anger, or disappointment and negatively impacting the patient's quality of life (AL-Hassan et al., 2014; Carr et al., 2017; Feuchtinger et al., 2014; McCormick et al., 2006; Teo et al., 1998). In addition, the duration of the waiting time may also influence the patients' psychological outcome (Feuchtinger et al., 2014). In a recent review, Salzmann et al. (2020) found that preoperative psychological preparation, for example improving knowledge and social support, may be able to reduce negative effects on post-operative outcome by optimising expectations and illness beliefs.

Cancellation or postponement of cardiac surgery may be caused by hospital/organisational (e.g. lack of available staff members, overbooking or lack of operation rooms, unavailable beds in the intensive care unit [ICU] or in the ward) or for patient-related reasons (e.g. febrile situations due to infections, neurological symptoms) or other clinical findings developed since the heart team established the indication for surgery (Tagarakis et al., 2011). With the emergence of the new corona virus disease 2019 (COVID-19) the risk of surgical postponement due to hospital/organisational causes was further increased (Thorup et al., 2021).

2 | BACKGROUND

Little is known about patients' psychological response, or how the patients' social support network responds to an extended waiting time, when elective cardiac surgery is postponed. In contrast, several studies examine cancellations from the perspective of the health system with the aim of reducing cancellations or postponements of elective surgery (e.g. Fitzsimons et al., 2016; Hori et al., 2016).

However, postponement of cardiac surgery cannot be completely prevented in clinical practice, and there is still a lack of knowledge regarding associations between postponement of cardiac surgery and psychological responses and clinical outcomes comparing patients who experience postponement of surgery with patients who undergo surgery as initially scheduled.

3 | THE STUDY

A current increase in surgical postponements for non-patient-related reasons experienced in our hospital during the recent years prompted this study, in which we aimed to investigate patients' psychological reactions to postponement of elective cardiac surgery.

Key points

- Postponement of surgery is not consistently associated with psychological distress, although some patients may need psychosocial support during the extended waiting period.
- Postponements were not associated with increased post-operative complications suggesting that when postponements cannot be avoided, doctors are able to identify patients who do not experience increased risk in relation to postponement.
- Organizational/hospital related causes are still the most common reason for postponement.

We hypothesized that psychological distress, such as anxiety and depression, is more prevalent during the waiting time for surgery among patients who experience postponement compared with patients who undergo surgery as scheduled. As social support is an important factor for especially post-operative anxiety (Salzmann et al., 2020), we also wanted to explore whether social support as experienced by the patients differed between postponed and non-postponed patients. We therefore examined changes in psychological outcomes from pre-surgery to 6 months post-operative to explore whether there were any long-term associations between psychological factors and experienced social support of postponement. As secondary outcomes, we registered causes of postponements, and whether postponed patients developed complications during the extended waiting period.

4 | METHODS

4.1 | Design

This study was a single-centre, observational prospective cohort study. We investigated patients' reactions to postponement of open cardiac surgery by comparing a group of patients who experienced postponement of elective surgery with a group of patients who underwent surgery on the originally planned date. To ensure high-quality presentation of the conducted observational study, we

followed the 'Strengthening the Reporting of Observational Studies in Epidemiology' (STROBE) (von Elm et al., 2008) (Table S1).

4.2 | Study setting and sampling

The study was conducted in the Department of Cardiothoracic Surgery, Aalborg University Hospital, Denmark, between 1 October 2019 and 31 December 2020. Almost all kinds of adult cardiac surgery are performed in the hospital except for transplantations and surgeries for adult congenital heart diseases. Aalborg University Hospital is one of four public hospitals performing cardiac surgery in Denmark serving a population of approximately 600,000 people in the North Denmark Region. Between 360 and 400 open cardiac surgeries have been planned to be performed annually during recent years. Each year the number of available staff members needed ICU beds and beds in the ward is adapted for the planned operative activity several months in advance by the administration of the Heart Centre. Resources for these surgeries are allocated in advance to the hospital from regional politicians each year as anyone who has been granted a residence permit and lives in Denmark has free access to the tax-supported healthcare system in Denmark including public hospitals.

Although cardiac patients are free to choose between all public hospitals in Denmark, only few patients living in the North Denmark Region wish to be referred to hospitals outside the North Denmark Region in general—even if surgeries are postponed. Less than 10 cardiac surgeries are performed annually in a private hospital where patients are expected to pay themselves or through a private health insurance. No patients from the North Denmark Region underwent open cardiac surgery in the private hospital during the study period.

4.3 | Inclusion and exclusion criteria

Adult patients (≥18 years of age) referred to Aalborg University Hospital for elective open cardiac surgery who had received information regarding the date of surgery were eligible for inclusion in the study. Patients were excluded if emergent or urgent surgery was indicated, or if the patient was not able to read and understand Danish. Pregnant patients and patients who were sedated and intubated prior to surgery were also excluded. Patients who initially were included as control patients but in whom surgery was later postponed were excluded from the study as these patients did not have the opportunity to answer all questions for postponed patients under the same circumstances as patients included as originally postponed patients. Patients in whom surgery was definitively cancelled were also excluded from analyses. If patients were to undergo a second cardiac surgical procedure within the study period, only the initial surgery was considered the index event in the study.

When surgeries were postponed, the cause for postponement was registered as part of the postponement procedure. If there were several simultaneous causes for postponement, we registered the first cause mentioned by the surgeon. Patients received information regarding a new date of surgery either in the hospital or by phone or mail prior to the new date for hospitalisation.

Included patients were divided into two groups depending on whether their first scheduled surgery had been postponed: the postponed group was comprised of patients who experienced postponement of surgery for any reason after the patient had received information regarding the date of surgery. The non-postponed group consisted of patients who underwent surgery as originally scheduled without postponement of surgery. Originally, we planned to perform a matched study selecting two to three controls matched by demographic and operative characteristics. However, due to an increasing number of postponements early in the study period for hospital-related reasons (Thorup et al., 2021), we decided to change this strategy and perceived all non-postponed cases as eligible for the control group. This was done to be able to construct a control group of patients arising during the same time period as the postponed cases.

Prior to the study we did not expect large numbers of postponements, hence we did not perform an a priori power analysis for estimating the preferred sample size. Instead, we decided to collect a convenient sample over the course of 15 months.

4.4 | Data collection

Questionnaires on anxiety, depression and social support were filled in by the patients on the last working day prior to their surgery and 6 months post-operative. Patients, who were hospitalised prior to the scheduled surgery, that is the last working day before surgery, were contacted in the ward prior to surgery by a research nurse and invited to participate in the study. When invited, they were given study information and a consent form, and if they agreed to participate, they were asked to fill in questionnaires in the ward on the day before surgery. If patients were postponed prior to hospitalisation or a research nurse was not able to invite the patient face-to-face in the ward, they were contacted at home by phone. Study information and consent form were then sent to the patients, and care was taken that they did not fill in the questionnaire until the day prior to surgery. If patients experienced postponement of surgery more than once, questionnaires were only handed out to the patient in relation to the first rescheduled surgery. At 6 months post-operative, questionnaires were sent to the patients.

As a lockdown was imposed in Denmark on 11 March 2020, due to the emerging COVID-19 pandemic, we were not able to include patients for a period of 27 working days, as all research staff members were sent home from work in the hospital from 11 March to 23 April 2021.

Demographic data and preoperative medical parameters were retrieved prospectively from the patient records. Complications during the extended waiting period for postponed patients were also registered, that is urgent, or emergent referral due to severe aggravation of myocardial insufficiency or acute coronary syndrome

including both non-ST segment elevation myocardial infarction (NSTEMI) and ST segment elevation myocardial infarction (STEMI) with the need of surgery prior to scheduled surgery, stroke verified with either computer tomography or magnetic resonance imaging, and cardiac death.

In addition, the reasons for postponement of surgery and number of days waiting for the rescheduled surgery as well as operative data and information regarding postoperative complications until 30 days postoperative was registered (stroke verified as described above; acute renal insufficiency needing dialysis; acute myocardial infarction defined as biomarker values above five times the 99th percentile of the normal reference range when associated with the appearance of new pathological Q-waves or new left bundle branch block, angiographically documented new graft or native coronary artery occlusion, or imaging evidence of new loss of viable myocardium; development of deep purulent infection involving the sternum and/or the mediastinum or sternal dehiscence leading to re-operation, time in the ICU and number of postoperative days in the hospital until discharge).

4.4.1 | Psychological measures in the questionnaire package

Hospital Anxiety and Depression Scale (HADS)

The HADS measures anxiety and depression symptoms devoid of somatic complaints (Zigmond & Snaith, 1983). It consists of 14 items, 7 items for anxiety and depression subscales respectively, answered on a 5-point Likert scale of 0–4. Scores range from 0 to 21 with scores of 8 and above suggesting a symptom level of diagnostic relevance (Bjelland et al., 2002). Although the diagnostic accuracy of the scale has been questioned, it may be used as a relevant screening instrument for emotional distress (Brennan et al., 2010). In the current study we used the original subscales as indicators of anxiety and depressive symptoms rather than as a diagnostic tool and found internal consistency to be excellent (Cronbach's α [depression] = 0.93; Cronbach's α [anxiety] = 0.87 in the current study), and in agreement with the general literature on the HADS (Bjelland et al., 2002).

Cardiac Anxiety Questionnaire (CAQ)

The CAQ measures heart-focused anxiety, as this may be a more specific form of anxiety relevant to heart patients (Eifert et al., 2000; van Beek et al., 2012). The scale consists of 18 items answered on a 5-point Likert scale (0 [never]–4 [always]), that is higher scores indicate higher levels of anxiety. The CAQ was originally divided into three subscales: fear/worry, heart-focused attention, avoidance behaviour (Eifert et al., 2000). However, in the current study, we used a more recent subscale structure identified by van Beek et al. (2012), including a fourth subscale of safety-seeking behaviour (Cronbach's α [worry] = 0.81; Cronbach's α [heart-focused attention] = 0.70; Cronbach's α [avoidance behaviour] = 0.87; Cronbach's α [safety-seeking behaviour] = 0.72 in the current study). The scales have been shown to be sensitive to changes in heart-focused anxiety before and after surgery (Hoyer et al., 2008), and van Beek et al. found Cronbach's α ranging from 0.57 (safety-seeking behaviour) to 0.90 (avoidance behaviour).

Crisis Support Scale

The Crisis Support Scale consists of seven items answered on a 7-point Likert scale (0 [never]–4 [always]) (Elklit et al., 2001; Joseph et al., 1992). It has been converted from a semi-structured questionnaire into a questionnaire form and focuses on perceived social support in relation to a crisis or important life event, in this case having to undergo cardiac surgery. It is commonly used twice, once in relation to the event, and again after a relevant follow-up period in relation to the event. One item measures satisfaction with perceived support, whereas the remaining items are summed to a total score of perceived support (Cronbach's α = 0.52 in the current study). Elklit et al. (2001) found Cronbach's α of 0.75 and 0.67 for the scale at two different time points in the same sample.

4.5 | Data analysis

For the current study, we initially screened all data prior to analyses, and only retained cases with all clinical data available. For these data, we incorporated the methods for replacing missing data at the item level as described by Schafer and Graham (2002) for our psychological measures.

Based on this dataset, we then compared demographic, clinical and psychological data for our two groups at inclusion using *t*-test, Mann–Whitney, or chi-square as appropriate (see Tables 1 and 2). When appropriate, we also estimated effect sizes for these comparisons using either Cohen's *d* or Cramer's *V* (Cohen, 1992) as appropriate.

We used mixed linear models (MLMs) to compare postponed and non-postponed patients and examine changes over time on all psychological outcomes (anxiety and depression [HADS], worry, avoidance behaviour, heart-focused attention and safety-seeking behaviour [CAQ] and perceived social support [CSS]). As MLMs tolerate missing values at the observation level, that is summed scale scores, this gave us the option of also retaining cases in our analyses, even if summed scale scores for psychological data were missing at the observational level at either time point. Even though we included all available postponed patients during our study period, our sample size is modest, hence we could only include a small number of covariates or factors in our model if we were to retain power. Therefore, we focused on variables of specific relevance to the patients' subjective experience of the postponement, that is waiting time and factors known to impact on outcomes, that is gender. Prior to analyses, we also categorised continuous waiting time into no waiting time (the control group), short waiting time (≤14 days) and long waiting time (>14 days) to retain power for analysis.

All psychological outcomes were treated as continuous, and all final reported MLMs were estimated using restricted maximum likelihood. Data were hierarchically arranged in two levels, with time

TABLE 1 Baseline demographic and clinical patient characteristics, including postponement-related information.

	Non-postponed patients ($n = 109$)[a]	Postponed patients ($n = 83$)[a]	p[b]	ES[c]
Age, years (mean ± SD) (108/82)	65.7 ± 9.50	67.9 ± 9.50	0.13	0.23 [−0.52–0.06]
Male (%)	90 (82.6)	60 (72.3)	0.12	0.12
Co-habiting (%)			0.71	0.06
Alone	20 (20.0)	14 (20.6)		
With spouse/partner	79 (79.0)	54 (79.4)		
With others	1 (1.0)	0 (0)		
Type of planned surgery			0.23	0.15
CABG	44 (40.4)	22 (26.5)		
Valve surgery	24 (22.0)	23 (27.7)		
Aorta surgery or AF stand alone	3 (2.8)	4 (4.8)		
Combined or other	38 (34.9)	34 (41.0)		
NYHA class (101/80)			0.73	0.09
I	25 (24.8)	19 (23.8)		
II	58 (57.4)	44 (55.0)		
III	17 (16.8)	17 (21.3)		
IV	1 (1.0)	0 (0)		
LVEF, median[IQR] (108/83)	60 [55–65]	60 [55–65]	0.35	-
BMI	27.63 ± 4.29 (108)	27.39 ± 4.96 (82)	0.72	0.05[−0.24–0.34]
Prescribed medication for depression/anxiety (108/83)	7 (6.5)	8 (9.6)	0.43	0.06
Hypertension	78 (71.6)	61 (73.5)	0.87	0.02
Hypercholesterolemia	73 (67.0)	60 (72.3)	0.53	0.06
Diabetes mellitus	25 (22.9)	16 (19.3)	0.60	0.04
Renal insufficiency (106/83)	10 (9.4)	7 (8.4)	1.00	0.02
Previous apoplexia/TCI	7 (6.4)	6 (7.2)	1.00	0.02
COPD	7 (6.4)	9 (10.8)	0.30	0.08
Log euroSCORE II, median[IQR] (105/81)	1.42 [0.92–1.92]	1.61 [0.61–2.61]	0.16	–
History of atrial fibrillation	24 (22.0)	28 (33.7)	0.07	0.13
Previous cardiac surgery	2 (1.8)	3 (3.6)	0.65	0.06
Reason for postponement	–		–	–
Patient related		5 (6.0)		
Hospital/organisational reasons		62 (74.7)		
COVID-19 pandemic		16 (19.3)		
Number of postponements	–		–	–
1		63 (75.9)		
2		16 (19.3)		
3 or more		4 (4.8)		
Days to surgery following postponement (79)	–		–	–
0–14 days		7.62 ± 4.12		
15 days and more		43.71 ± 25.40		

Abbreviations: BMI, body mass index; CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association; TCI, transitory cerebral ischaemia.

[a]Unless indicated by actual *n* available for the analyses in parentheses following the variable name, there were no missing cases for a specific variable.

[b]*t*-Tests are indicated by means and SD and a 95% CI for ES, chi-squared tests are indicated by (%) and ES, and Mann–Whitney tests are indicated by median[IQR] and no associated value for ES.

[c]Effect sizes are calculated as either Cramer's *V* or Cohen's *d* depending on the type of data and subsequent analyses. For Cramer's *V* (i.e. chi-square analyses) 0.1–0.3 indicates a low, 0.3–0.5 indicates a medium, and >0.5 indicates a high association between measures, whereas for Cohen's *d* (i.e. *t*-tests) 0.2 indicates a small, 0.5 a medium, and 0.8 a large effect size.

TABLE 2 Means and SD for multilevel modelling analyses for all outcome measures.

	Postponed		Non-postponed		Time			Time × group interaction effect		
	Prior to OP[a]	6 months OP	Prior to OP[a]	6 months OP	*F*		*p*	*F*	*p*	d
HADS										
Angst	8.82 ± 5.15	4.23 ± 4.94	8.16 ± 5.73	3.32 ± 3.71	121.38	−4.71 [−6.03-(−3.39)]	**0.00**[b]	0.02	0.89	0.07
Depression	8.63 ± 4.92	3.18 ± 3.77	8.14 ± 5.46	3.62 ± 4.11	131.60	−5.77 [−7.1-(−4.42)]	**0.00**[b]	2.36	0.13	0.26[c]
CAQ										
Avoidance	1.95 ± 0.99	0.92 ± 0.87	1.56 ± 0.91	0.75 ± 0.65	115.25	−1.08 [−1.35-(−0.81)]	**0.00**[b]	2.43	0.12	0.27[c]
Heart-focused attention	1.31 ± 0.75	1.21 ± 0.70	1.16 ± 0.71	1.02 ± 0.64	4.98	−0.15 [−0.36–0.05]	**0.03**[b]	0.02	0.89	0.02
Worry	1.16 ± 0.81	0.73 ± 0.79	1.06 ± 0.91	0.64 ± 0.77	46.02	−0.48 [−0.69-(−0.27)]	**0.00**[b]	0.09	0.77	0.05
Safety-seeking behaviour	1.71 ± 1.01	1.33 ± 0.97	1.79 ± 1.13	1.13 ± 1.01	31.65	−0.43 [−0.73- (−0.13)]	**0.00**[b]	1.58	0.21	0.22[c]
CSS										
Perceived social support	30.83 ± 5.04	29.11 ± 5.91	31.90 ± 4.99	29.13 ± 4.71	21.54	−1.97 [−3.48-(−0.45)]	**0.00**[b]	0.48	0.49	0.12
Satisfaction with social support	6.28 ± 1.04	6.43 ± 0.96	6.40 ± 0.93	6.01 ± 1.30	1.16	0.12 [(−0.21)-0.45]	0.28	4.94	**0.03**[b]	**0.40**[c]

[a] *t*-Tests showed no significant differences between groups on any measures at baseline.

[b] Significance level of $\alpha = 0.05$.

[c] small effect size according to Cohen (1992).

at Level 1 nested within individuals at Level 2. Our basic model included a random effect for the intercept, and fixed effects for time, group and the time×group interaction. In the following models we added first gender and then waiting time categorised as described above as factors. We used a diagonal covariance structure as AIC and BIC indicated this to be the best choice (Heck et al., 2010). As tested models were nested, final model selection was based on test of −2LL change (Heck et al., 2010). We only retained gender in the analyses including waiting time if it significantly improved model fit on its own. Effect sizes for the final models were calculated as Cohen's *d*. All alpha levels were set at 0.05. We used SPSS 28.0 for all analyses.

4.6 | Ethical considerations

Requirements according to the General Data Protection Regulation adopted by the European Union as from 25 May 2018, and the Danish data protection agency were fulfilled. Furthermore, the study adhered to the Declaration of Helsinki. The study protocol was approved by the Head of the Department and registered by the hospital (ID-number 2019-128). Acceptance from the Committee on Health Research Ethics for North Denmark was waived due to the observational design of the study.

5 | RESULTS

5.1 | Characteristics of the sample

A total of 464 surgeries were planned during the study period; however, some patients experienced postponement of surgery more than once and were therefore allocated to more than one scheduled surgery during the study period. In total, 145 patients experienced 185 postponements after they were informed about the date of surgery during the study period. The number of postponed surgeries prior to the COVID-19 lock down was 56 of 131 planned surgeries (42%), and after the start of the COVID-19 pandemic including the rest of the study period, a total of 131 of 333 of planned surgeries (39%) were postponed.

The numbers of individual patients participating at each stage of the study are shown in Figure 1. Due to the change in the composition of the control group, we failed to include 178 potential control patients during the beginning of the study, and after exclusion of other non-eligible patients, a total of 109 control patients and 83 patients had all clinical data available and made up our full sample for analyses. Demographic data and preoperative medical parameters for our full sample are shown in Table 1. Among the postponed patients, 63 (75.9%), 16 (19.3%), and 4 (4.8%) experienced postponement of their surgery 1, 2 and ≥3 times, respectively. Postponement of surgery for hospital/organisational reasons was by far the most common cause for postponement of elective surgery during the study period (Table 1). The reasons for postponements for hospital/organisational reasons were a mixture of lack of available beds in the ICU, lack of beds in the ward, lack of available staff members both in the operation room and in the ICU. A total of 16 patients were postponed immediately due to lock down of elective cardiac surgeries caused by the COVID-19 pandemic outbreak. There were no significant differences on any of these measures at inclusion (Table 1). We also compared psychological measures at inclusion and found a significant difference only for the avoidance subscale on the CAQ ($t = -2.65$, $p = 0.009$).

5.2 | Psychological reactions to postponement

Our MLM analyses indicated that a model containing random and fixed effects for the intercept and fixed effects for time, group, waiting time, and the time×group interaction was the best fit for all outcomes based on the −2LL statistics, except perceived support, for which the model with best fit also included gender. The interaction term group×time was only significant for satisfaction with social support ($F = 4.94$, $p = 0.03$), which was associated with an ES of 0.40 (Table 2). On further examination analyses showed that postponed patients maintained the same level of satisfaction with support over time ($F = .65$, $p = 0.42$), whereas patients who were not postponed showed a significant decrease in satisfaction over time ($F = 4.8$, $p = 0.03$). For depression, avoidance and safety-seeking behaviour ES ranged from 0.22 to 0.27, whereas for the remaining scales ES ranged from 0.02 to 0.12 (Table 2). Overall, we found significant improvements on the HADS and CAQ over time across groups (Table 2), whereas satisfaction with social support did not reach significance and perceived social support decreased over time, but only in the non-postponed group ($F = 13.81$, $p < 0.01$) (Table 2). Furthermore, our analyses indicated no significant differences for the intercept, although immediately before surgery both patients who waited more than 14 days and control patients scored lower on depression (HADS) ($t = 2.33$, $0 = 0.021$) and higher on experiencing support ($t = 2.48$, $p = 0.014$) compared to patients who waited between 0 and 14 days. Of note, for anxiety and heart-focused attention, this comparison fell just short of significance (p's = 0.06–0.07). In addition, male patients perceived less support compared to female patients ($t = -2.61$, $p = 0.01$), also indicated by the inclusion of gender in the MLM model for perceived social support. Contrary to our expectations, we found no overall effect of group allocation over time, indicating that being postponed was not associated with increased psychological distress at baseline, and that psychological distress generally decreased over time in both groups (Table 2).

Complications were rare during the extended waiting period for postponed patients. One patient suffered a stroke, but there was no incidence of acute myocardial infarctions or aggravation of myocardial insufficiencies leading to emergent or urgent surgery. No patients died during the extended waiting period.

Furthermore, there were no differences between the groups regarding the number of postoperative days in the ICU (1.6 days for control patients and 1.2 days for postponed patients, $p = 0.21$) and

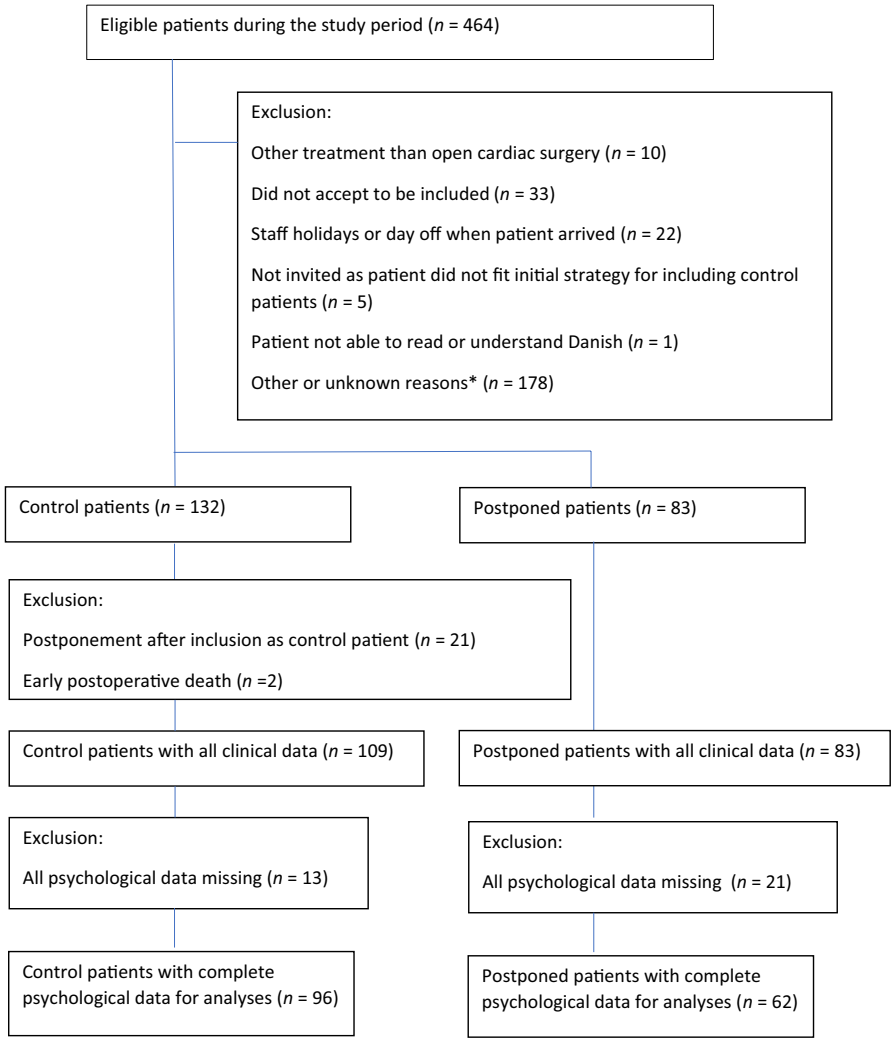

FIGURE 1 Flow chart of study inclusion. *The other and unknown category consists of control patients who were not approached due to the initial strategy of matching control patients to postponed patients and patients who were admitted, while all non-essential hospital staff were sent home due to the COVID-19 pandemic.

the number of postoperative days in the hospital (9.4 days for control patients and 7.9 days for postponed patients, $p = 0.33$). Two patients in the control group and one patient in the postponed group suffered a postoperative stroke and one patient in each group suffered a postoperative myocardial infarction, which were both treated without the need of re-operation. Two patients in the control group needed temporary postoperative haemodialysis. There were no deep sternal wound infections and no postoperative deaths within 30 days postoperative.

6 | DISCUSSION

In the current study, we found limited support for our hypotheses of postponement being associated with increased psychological distress, as only satisfaction with social support was significantly different across our two groups over time. However, postponed patients waiting 0–14 days had higher levels of depression and higher levels of perceived social support just before their surgery compared to both controls and postponed patients waiting more than 14 days. In addition, our results also indicate that male patients are less likely to experience social support than female patients. Over time, all psychological outcomes improved significantly in both groups, except perceived social support, which decreased significantly over time in our non-postponed patients, and satisfaction with social support, which did not reach significance except as part of a time × group interaction.

In general, none of our postponed patients experienced serious complications during the extended waiting period, suggesting that the strategy employed by our heart team for identifying patients who are eligible for postponement is effective.

Contrary to our expectations, we found no overall effect of postponement on psychological distress; however, our results are in line with those in the literature, as we found that patients generally are experiencing psychological distress prior to cardiac surgery, regardless of whether their surgery is postponed or not. Preoperative increases in anxiety and depression are not uncommon (Gorini et al., 2022; Thorup et al., 2021), and the increased avoidance behaviour found in the postponed patients may indicate that patients try to accommodate to their knowledge of needing surgery, and therefore avoid activities, especially physical activities, that may worsen their condition while they wait. Whether this avoidance is in accordance with recommendations from their clinicians is beyond the scope of our data, but as such, it indicates that patients may

TABLE 3 Means and SD for baseline outcome measures based on covariate groupings in multilevel modelling analyses.

	Male	Female		*p*	No waiting time	Brief waiting time	Long waiting time		*p*
Anxiety	8.14 ± 5.51	9.44 ± 5.44	−1.06 [−2.66–0.54]	0.19	8.16 ± 5.73	9.85 ± 5.38	8.21 ± 4.85	2.34 [0.23–4.44]	**0.03**[a]
Depression	8.32 ± 5.14	8.37 ± 5.68	−0.09 [−1.59–1.41]	0.91	8.14 ± 5.46	10.16 ± 4.46	7.69 ± 4.90	2.33 [0.36–4.29]	**0.02**[a]
Avoidance	1.71 ± 0.94	1.69 ± 1.05	0.02 [−0.25–0.30]	0.86	1.56 ± 0.91	2.03 ± 0.90	1.92 ± 1.05	−0.06 [−0.42–0.30]	0.73
Heart-focused Attention	1.23 ± 0.74	1.19 ± 0.67	0.05 [−0.18–0.28]	0.65	1.16 ± 0.71	1.33 ± 0.84	1.31 ± 0.69	0.29 [−0.02–0.59]	0.07
Worry	1.10 ± 0.89	1.11 ± 0.83	−0.08 [−0.37–0.20]	0.57	1.06 ± 0.91	1.27 ± 0.94	1.10 ± 0.68	0.25 [−0.13–0.63]	0.20
Safety-seeking	1.83 ± 1.05	1.52 ± 1.17	0.23 [−0.12–0.58]	0.19	1.79 ± 1.13	1.70 ± 1.11	1.72 ± 0.95	−0.14 [−0.60–0.33]	0.56
Perceived social support	31.26 ± 5.05	32.25 ± 4.90	−2.17 [−3.80- (−0.55)]	**0.01**[a]	31.90 ± 4.99	32.07 ± 4.20	29.72 ± 5.44	2.69 [0.55–4.83]	**0.01**[a]
Satisfaction with social support	6.35 ± 1.00	6.36 ± 0.90	−0.04 [(−0.38)-0.30]	0.81	6.40 ± 0.93	6.36 ± 0.99	6.19 ± 1.09	0.07 [(−0.38)-0.52]	0.76

[a]Significance level of $\alpha = 0.05$.

consider avoidance of physical activities as the best way of looking after themselves while waiting.

Immediately before surgery, we did find increased anxiety and depression in patients postponed for a short time (0–14 days) compared to non-postponed patients and patients postponed longer than 14 days. This could indicate that while a postponement initially may be associated with increased anxiety or depression, as in the group waiting briefly, this changes when the waiting period extends beyond 14 days. This suggests that while there may be an initial elevation in psychological distress associated with postponement, this does not seem to linger over time, not even if a patient continues to wait for surgery for an extended period. The decrease in psychological distress over time while waiting may be due to habituation to waiting for surgery, or alternatively, psychological distress decreases as patients ascribe meaning (i.e. I am able to tolerate waiting) to the fact that their surgery is postponed (Thorup et al., 2021) resulting in waiting no longer being associated with increased distress. Taken together, our results suggest that our current knowledge regarding anxiety and depression in relation to cardiac surgery may also apply when cardiac surgery is postponed. However, since increased psychological distress is common before surgery, this suggests that preparing patients psychologically before surgery, monitoring psychological distress and intervening appropriately in relation to postponement or surgery-related psychological distress may nevertheless be important to avoid post-operative complications related to psychological distress (Salzmann et al., 2020).

Our results also show that perceived social support decreased for both groups over time, whereas satisfaction with social support remained the same over time in the postponed patients, whereas it decreased significantly for non-postponed patients. This may suggest that the postponement initiated satisfactory social support for postponed patients, and that this effect did not wear off over time, whereas in contrast, non-postponed patients initially experienced satisfactory social support, but this did not last, although they desired it. As suggested, increasing social support pre-surgery may be protective against psychological distress related to surgery (Salzmann et al., 2020); however, it may also be important to continue to monitor whether patients experience satisfactory support post-operative.

To our knowledge, there are no studies examining what specific needs for support patients may have when their surgery is postponed, and in consequence the support that we offer may be mismatched in relation to the patient's need. However, our results indicate that perhaps the postponement does in fact increase the probability of increased satisfactory support even if the perceived social support decreases over time. Of note, our results indicate (Table 3) that women are more likely than men to experience social support, which is consistent with the literature in general (Elklit et al., 2001). This further suggests that if planning pre- or post-operative psychological interventions, it may also be imperative to incorporate more gender-specific interventions when addressing potential psychological distress.

Postponement of surgery for hospital/organisational-related reasons may include, for example, lack of available staff members, overbooking or lack of operation rooms, unavailable beds in the ICU or in the ward (Tagarakis et al., 2011; Thorup et al., 2021; Viftrup et al., 2021). Postponement of cardiac surgery for patient-related reasons including same-day cancellations, may be due to medical reasons, such as infections causing fever, neurological symptoms or other clinical findings developed since the heart team established the indication for surgery (Tagarakis et al., 2011) and pre-incisional complications in the operating room (Smith et al., 2014). Development of the COVID-19 pandemic during the study period resulted in a new cause of postponement of elective surgeries which was unknown prior to 11 March 2020. Initially during the pandemic, surgeries were postponed making sure that resources (intensive care staff members and ventilators) were available in case the pandemic exploded. Later postponement for hospital/organisational reasons—for example, lack of doctors or nurses in the operation room—may also have been indirectly related to the pandemic, as some staff members was relocated to the Department of Infectious Diseases and to the ICU. Of note, we found no differences in the number of cancellations before and after the COVID-19 pandemic indicating that the high frequency of postponements during the study period cannot be explained by the pandemic alone. This suggests that our results may be relevant to daily clinical practice, and not just applicable to patients' experience during a pandemic.

The main reason for postponement of surgery in the present study was hospital/organisational related due to a mixture of different causes. An integrative review on cancellation of different kinds of surgeries prior to the pandemic (Talahwab & McIltrot, 2019) described that postponements of elective surgeries are a multifactorial problem existing worldwide, and that hospital-related causes are predominant. Among 94 out of a total of 575 patients scheduled for cardiac surgery in Greece (16%), the reasons were also mainly organisational related (52%), which is in line with our findings. Organisational postponements of planned surgeries may be avoidable, for example when economic savings leads to a lack of staff members, when there is a lack of available rooms for surgery or when planned repair of hardware in the operating rooms is going on. Hence, care should be taken to monitor the impact of lack of staff or operation rooms and include such factors in scheduling, to avoid overbooking, or having to postpone patients, who are already informed of their date of surgery.

6.1 | Strength and limitations of the work

The current results must be interpreted with the following limitations in mind. As the present study was an observational study with a limited sample size, we were not able to adjust for all potential confounding factors, nor examine the main effect of such factors. As such, development of postoperative atrial fibrillation, which is frequently reported following cardiac surgery, has been shown to be associated with anxiety symptoms in the postoperative period (Tully et al., 2011). However, we did not adjust the result of the present study for development of atrial fibrillation in the postoperative period, as development of atrial fibrillation is not systematically monitored postoperative and registered in any databases in Denmark. Other complications may also potentially act as confounding factors. However, we have no reason to believe that any major complications played any role in relation to the primary findings in the present study, as the number of severe complications in both groups were low and without any differences between the groups. However, the emergence of the COVID-19 pandemic during our study period may have had an impact on our findings, especially psychological data, in that many patients became increasingly worried of attending hospitals, as well as undergoing surgery due to the risk of infection associated with physical attendance at hospital.

In addition, our sample was relatively modest, which may have resulted in reduced power in detecting any relevant differences, especially in relation to our MLM analyses, as we could not include all potentially relevant factors in our analyses. This may have been further attenuated by the fact that we did not obtain psychological data for our full sample, as some patients did not fill in questionnaires at either time point. Also, we did not adjust for multiple comparisons; instead we calculated ES for our MLM models, as we wanted to obtain indicators of clinical impact of our findings related to the various outcomes. Finally, our results regarding social support may be affected by the fact that the internal consistency of this measure was inferior to that reported in the literature.

6.2 | Recommendations for further research

Future studies should aim for larger samples focusing on both clinical and psychological data with the aim of replicating these findings and furthering our understanding of the impact of postponement of elective cardiac surgery.

6.3 | Implications for policy and practice

The findings from the present study confirms that organisational/hospital-related causes are still the most common cause for postponement of elective cardiac surgeries, indicating that hospital administrations and doctors need to improve planning of this activity. Postponement of surgery may increase levels of depressive symptoms prior to surgery, and some patients may need psychosocial support during the extended waiting period. Although the COVID-19 pandemic resulted in postponements of surgeries, this pandemic may not be blamed for postponements in general, as the frequency of postponed surgeries was the same prior to the pandemic. Even if postponements may not be totally avoided, it seems

that doctors are able to identify which patients may be postponed without any increased risk for the patients.

7 | CONCLUSION

We found no persistent differences in psychological impact across groups, although satisfaction with social support decreased significantly in our non-postponed patients over time. However, for those waiting briefly (0–14 days) we found increased levels of depressive symptoms prior to surgery compared to our controls and those waiting more than 14 days. In addition, there were no increases in complications associated with postponement. Taken together, this suggests that postponement of selected patients is not per se associated with increased risk of psychological distress or post-operative complications; however, it may be important to target information for patients to avoid complete inactivity, provide social support, and in some cases psychological interventions during the waiting time. In contrast, our results indicate that the methods used for selecting patients for postponement are targeting patients, who do not develop increased levels of complication.

AUTHOR CONTRIBUTIONS

Helle Spindler: conceptualization (supporting), formal analysis (lead), methodology (equal), writing – original draft preparation (equal). **Charlotte Bruun Thorup**: Conceptualization (supporting), Investigation (supporting), Writing – review & Editing (equal). **Dorte Nøhr**: conceptualization (supporting), data curation (lead), investigation (lead), writing – review & editing (equal). **Jan Jesper Andreasen**: Conceptualization (lead), data curation (supporting), methodology (equal), Writing – original draft preparation (equal).

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CONFLICT OF INTEREST STATEMENT

All authors declare that there are no conflicts of interest.

DATA AVAILABILITY STATEMENT

The authors elect to not share data as patients have not given consent to data sharing, and therefore data sharing would not be in accordance with the European General Data Protection Regulation as of 25 May 2018.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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