Children's and Parents' Anxiety Levels pre and post Thoracoplasty. Play Specialist-based Intervention beneficial Outcomes

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Abstract

Paediatric surgery elicits anxiety in children and their parents. The present study tests the impact of Play Specialist-based intervention (PS) on children's and parents' anxiety pre and post thoracoplasty. The study was held at Gaslini pediatric hospital (Genoa, Italy) and involved families with a child undergoing thoracoplasty to correct children's pectus carinatum (PC) or excavatum (PE). Children provided with PS-based intervention (n=40) were compared with control children (n=32). The mothers of PS children (n=40) were compared with the control mothers (n=32), and the fathers of PS children (n=40) were compared with the control fathers (n=32). Visual Analog Scale (VAS) was administered to assess pre and post thoracoplasty anxiety. T-tests and Analyses of Covariance (ANCOVA), Bayes factors for t-tests and ANCOVA were computed. A significant interaction effect between time and group (i.e., PS and controls) emerged for children, mothers, and fathers. Bonferroni post-hoc analyses revealed that PS

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children's and PS mothers' postoperative anxiety was lower than controls' postoperative anxiety. PS fathers' experienced greater preoperative anxiety than controls and no significant differences with control fathers emerged in postoperative anxiety. PS-based intervention emerged to reduce children's and parents' anxiety over time, and to diminish children's and mothers' postoperative anxiety in comparison with the controls.

Keywords: hospital, thoracoplasty, children, parents anxiety, play specialist

Introduction

Thoracoplasty is a surgical procedure that was introduced in the 19th century to treat lung tuberculosis and chronic pleural empyema (Odell, 2012; Hecker, Hecker & Hecker, 2012; Kuhtin, Veith, Alganew, Martel, Giller, Haas et al., 2020). Still, this procedure is beneficial in treating children's chest wall deformities like pectus carinatum (PC) and pectus excavatum (PE)

(Waters, Welch, Micheli, Chamberger & Hall, 1989; Robicsek, Cook, Dauherty & Selle, 1979). Pectus carinatum (PC) indicates three types of deformities characterized by sternum prominence (Feng, Hu, Liu, Zhang, Thang, Chen et al., 2001): (a) Type I (Keel Chest) consisting of a protrusion of symmetrical costal cartilages and sternum; (b) Type II (Pouter Pigeon Breast) consisting of the protrusion of the first two sternal cartilages and the manubrium; (c) Type III (Lateral Pectus Carinatum) consisting of a chest wall unilateral protrusion. Pectus excavatum (PE) indicates an anterior chest wall deformity, consisting of depression of the lower costal cartilages and the sternum (Feng et al., 2001, Waters et al., 1989).

Between 50 and 70% of children undergoing surgery are likely to develop preoperative anxiety (Aranha, Sams & Saldanha, 2017). Preoperative anxiety is an intense feeling of threat that starts with surgery date planning and peaks when the patient enters the hospital (Jawaid, Mushtaq, Mukhtar & Khan, 2007). Among children, such a negative emotion is a risk factor for higher postoperative pain intensity, abnormal hemodynamic responses, and wound healing delays (Moura, Dias & Pereira, 2016). Preoperative anxiety is the cause of children's increased cry, augmented motor tone, and attempts to escape the medical procedures (Kain, Mayes, O'Connor & Cicchetti, 1996; Kain & Mayes, 1996). Typical postoperative symptoms are increased separation anxiety, nightmares, distress, and they persist in 54% of children presenting anxiety symptoms

up to two weeks after surgery, and 20% up to six months (Kain, Wang, Mayes, Caramico & Hofstadter, 1989; Kotiniemi, Ryhanen & Moilanen, 1997).

Parents of children undergoing surgery also exhibit high anxiety levels (Pomicino, Maccacari & Buchini, 2018; Shirley, Thompson, Kenward & Johnston, 1998). Parental anxiety extends from hospitalization time (e.g., during child surgery) to post-hospitalization (e.g., after child surgery) (Thompson, Irwin, Gunawardene & Chan, 1996), also persisting during the child's recovery (Kain et al., 1996). High parental anxiety contributes to increase or mantain the child's anxiety state before and after surgery (Kampouroglu, Velonaki, Pavlopoulou, Drakou, Kosmopoulos, Kouvas et al., 2020), and affects the surgical consultation and the process of informed consent (Chotai, Nollan, Huang & Gosain, 2017).

This background of evidence highlights the need for proper strategies to address the issue. The Play Specialist (PS) intervention has been demonstrated effective in diminishing preoperative and postoperative anxiety in a wide range of pediatric conditions (Gill, 2010; Moore, Bennet, Dietrich & Wells, 2015; Li, Chung, Ho, Kwok, 2016; Wong, Ip, Kwok, Choi, Ng & Chan, 2018; Ullan & Belver, 2019) and it could serve counteracting pre and post thoracoplasty anxiety levels. PS intervention aims at structuring a personalized play program for the pediatric patient (Webster, 2000, Perasso et al., 2021). The PS intervention increases hospitalized pediatric patients' resilience, diminishing distress towards the medical procedures (Dolan, 1993; Hart-Spencer & Griffiths, 2015). PS playing sessions can include: i. medical play (McCue, 1988); ii. playing with puppets, storytelling, or art and music activities (Sposito, Montigny, Sparapani, Lima, Silva-Rodriguez et al., 2016); Eventually, the intervention of PS can be associated with pet-therapy and educational video-gaming pet-therapy (Kaminski, Pellino & Wish, 2002; Vagnoli, Caprilli, Vernucci, Zagni, Mugnai & Messeri, 2015); educational video-gaming (Jurdi, Montaner, Garcia-Sanjuan, Jaen & Nacher, 2018).

The aim of the present study was to test whether the PS-based intervention significantly reduces children's and parents' preoperative and postoperative anxiety levels before and after thoracoplasty for pectus deformities.

Method

Procedure

The study was held at Gaslini Pediatric Hospital (Genoa, Italy) between March 2017 and March 2019. PS-based intervention was realized by Porto dei Piccoli no-profit association (Genoa, Italy). Ethical approval

was sought from Gaslini Ethical Committee in February 2017 after Porto dei Piccoli Consultive and Scientific Committee's preliminary approval of the research project. Before research kickoff, the parents received informative documentation around the research (e.g., aims, measures, processing of personal data) and returned informed consent for their own and the child's participation. Children from Gaslini Surgery ward who had to undergo thoracoplasty for pectus deformities were selected for the study, alongside with their parents, under consent documentation completion. Children were assigned to two conditions based on a convenience condition: i. children provided with PS-based intervention once a week (and their parents; PS), and ii. children not provided with PS-based intervention (and their parents; controls). Three pairs were considered: children (PS vs. controls), mothers (PS vs. controls), fathers (PS vs. controls).

Sample

PS children were n=40 (Mean$_{age}$=15.34, SD=2.25, min=10, max=18; Males=80%); Control children were n=32 (Mean$_{age}$=14.47; SD=2.11; min=11, max=18; Males=75%). PS mothers were n=40 (Mean$_{age}$=47.62; SD=6.86; min=29, max=55); control mothers were n=32 (Mean$_{age}$=47.53; SD=5.96; min=38, max=59). PS fathers were n=40 (Mean$_{age}$=47.33; SD=5.01; min=41, max=55); control fathers were n=32 (Mean$_{age}$=51; SD=5.92; min=42, max=59).

Instruments

Visual Analog Scale (VAS) (Hornblow & Kidson, 1976; Williams, Morlock & Feltner, 2010) was administered before thoracoplasty (e.g., during the first day of hospitalization) to measure preoperative anxiety in children, mothers, fathers (t1). Plus, VAS was administered 24 hours after thoracoplasty to measure postoperative anxiety in children, mothers, fathers (t2). VAS consists of a segmented line with numbers ranging from 0 to 10. The participant is required to self-rate his/her perceived state of anxiety by marking a position on the line.

Analytic Plan

Frequentist statistics were computed using p-value (with statistical significance level at $p< 0.05$) to determine whether to accept or reject the null hypothesis H_0 (i.e., H_0 indicates that there is no difference between groups). T-tests for independent samples and three models of repeated measures Analysis of Covariance (ANCOVA) were implemented with

JASP 0.11.1 (Jasp Team, 2019) to compare PS and control children's, mothers', and fathers' anxiety levels (i.e., pre and post thoracoplasty), controlling for the child's and the two parents' mean age (i.e., PS parents' mean age=47.31, SD=6.27, min=29, max=60; control parents' mean age=49.07, SD=5.79, min=38, max=59). Post-hoc analysis conducted through Bonferroni post-hoc corrections were performed to deepen the significant main effects. Moreover, Bayes factors (BF_{10}) were computed to quantify the likelihood of the alternative hypothesis (H_1) compared to the null hypothesis (H_0). For the present analyses, the prior distribution corresponded to JASP default settings (*r* scale fixed effect = 0.5, *r* scale random effects = 1, *r* scale covariates = 0.354) (Jasp Team, 2019; Wagenmakers, Verhagen, Li, Matzke, Steingroever, Rouder et al., 2017).

Results

Frequentist analyses results

Descriptive statistics of the three pairs anxiety levels, across PS and control conditions, are illustrated in Table 1. Student's t-tests for independent samples revealed a significant difference between PS and control children in postoperative anxiety as measured by VAS t2 scores. Specifically, PS children VAS t2 scores (3.38±1.99) were significantly lower than control children scores (5.09±2.41) ($t(70)=-3.31$, $p<.01$, Cohen's $d=-.78$). A significant difference between PS and control mothers in postoperative anxiety (measured with VAS t2) was also found, with PS mothers reporting lower VAS t2 scores (5.27±2.02) than Control mothers (7.41±1.74), ($t(70)=-4.72$, $p<.001$), Cohen's $d=-1.12$. Finally, a significant difference between PS and control fathers in preoperative anxiety (measured with VAS t1 was found, with PS fathers showing higher VAS t1 scores (5.64±2.07) than control fathers VAS t1 (4.27±1.75) ($t(70)=2.98$, $p<.01$, Cohen's $d=.71$).

Tab. 1 - *Descriptive statistics of the three pairs in the two conditions. VAS t1 score indicates pre-thoracoplasty anxiety. VAS t2 score indicates post-thoracoplasty (24 hour later) anxiety. Independent Sample t-tests (T Student's) to compare PS groups vs. control groups are reported*

PS Condition Mean scores					
	Child VAS t1	**Child VAS t2**	**Mother VAS t1**	**Mother VAS t2**	**Father VAS t1**
N	40	40	40	40	40
Mean	5.02	3.38	7.08	5.27	5.64
SD	2.45	1.99	1.95	2.02	2.07
Minimum	0	0	0	0	0
Maximum	10	8	10	8	10
Control Condition Mean scores					
	Child VAS t1	**Child VAS t2**	**Mother VAS t1**	**Mother VAS t2**	**Father VAS t1**
N	32	32	32	32	32
Mean	4.18	5.09	6.31	7.41	4.27
SD	2.43	2.41	2.15	1.74	1.75
Minimum	0	0	2	4	0
Maximum	9	9	10	10	7
Independent samples t-tests					
		t		**df**	
Child VAS t1		1.42		70	
Child VAS t2		-3.31**		70	
Mother VAS t1		1.61		70	
Mother VAS t2		-4.72***		70	
Father VAS t1		2.98**		70	
Father VAS t2		-0.01		70	

Note:**p<.01, ***p<.001.

The first ANCOVA model was run to compare PS and control children anxiety levels pre and post thoracoplasty, controlling for the effect of child's age and parents' age (see Fig.1). The model revealed a signifi-

cant interaction effect of time*group ($F(1,68) = 35.89$, $p < .001$, $\eta^2 = .34$). No significant covariates (i.e., child's age, parents' age) effects and no between subjects effects emerged. The post-hoc analysis (Bonferroni's correction) on the interaction between time and group revealed that control children's anxiety grew over time from preoperative (VAS t1) to postoperative (VAS-t2) anxiety ($t(68) = 2.85$, $p = .03$) while PS children anxiety decreased over time ($t(68) = 5.83$, $p < .001$). Controls postoperative anxiety resulted higher than PS children's postoperative anxiety ($t(68) = 2.96$, $p = .02$).

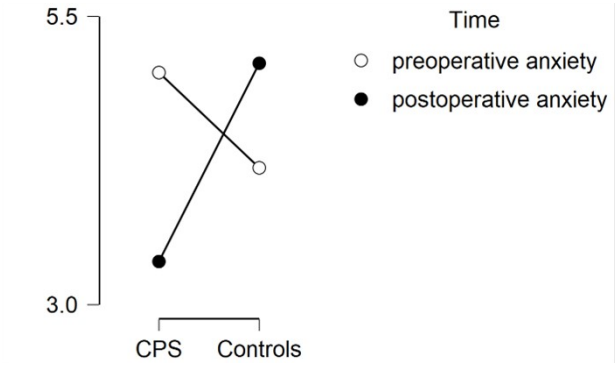

Fig. 1 - *Descriptive plot of ANCOVA comparing PS children and control children anxiety levels over time. PS children postoperative anxiety (VAS t2) is lower than preoperative anxiety (VAS t1); Control children postoperative anxiety (VAS t2) is higher than preoperative anxiety (VAS t1). PS children postoperative (VAS t2) anxiety is lower than controls*

The second ANCOVA model was performed to compare PS and control mothers' anxiety levels pre and post the child's thoracoplasty, controlling for the effect of child's age and parents' age (see Fig.2). The model revealed a significant interaction effect of time*group ($F(1, 68) = 61.87$, $p < .001$, $\eta^2 = .47$). No significant covariates (i.e., child's age, parents' age) effects and no between subjects effects emerged. The post-hoc analysis (Bonferroni's correction) on the interaction between time and group revealed that control mothers' anxiety grew over time from preoperative (VAS t1) to postoperative anxiety (VAS t2) ($t(68) = 4.04$, $p < .001$) while PS mothers' anxiety decreased over time ($t(68) = 7.33$, $p < .001$). Control mothers postoperative anxiety resulted higher than PS mothers' postoperative anxiety ($t(68) = 4.49$, $p < .001$).

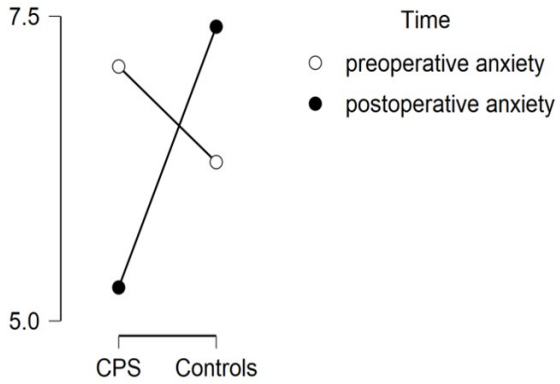

Fig. 2 - *Descriptive plot of ANCOVA comparing PS mothers and control mothers' anxiety levels over time. PS mothers postoperative anxiety (VAS t1) is lower than preoperative anxiety (VAS t1); Control mothers postoperative anxiety (VAS t2) is higher than preoperative anxiety (VAS t1). PS mothers postoperative (VAS t2) anxiety is lower than controls*

The third ANCOVA model was performed to compare PS and control fathers' anxiety levels pre and post the child's thoracoplasty, controlling for the effect of child's age and parents' age (see Fig.3). The model revealed a significant interaction effect of time*group $F(1, 68)= 11.32$, $p=.001$, $\eta^2=.14$. No significant covariates (i.e., child's age, parents' age) effects and no between subjects effects emerged. The post-hoc analysis (Bonferroni's correction) on the interaction between time and group revealed that PS fathers' preoperative anxiety (VAS t1) resulted higher than controls' ($t(68)=2.81$, $p=.03$). PS fathers' anxiety decreased over time, as postoperative anxiety resulted lower than preoperative ($t(68)=2.86$, $p=.03$). No significant differences emerged between PS and control fathers over time.

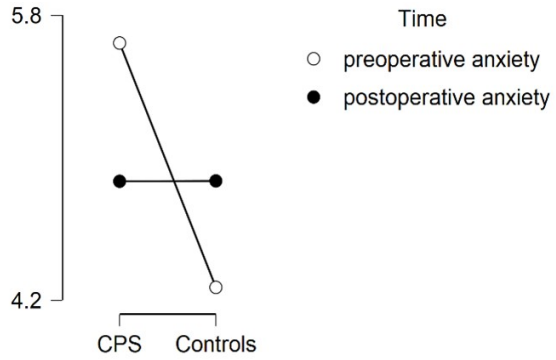

Fig. 3 - *Descriptive plot of ANCOVA comparing PS fathers and control fathers' anxiety levels over time. PS fathers' preoperative anxiety (VAS t1) is higher than postoperative (VAS t2). Control fathers' preoperative anxiety (VAS t1) is lower than postoperative (VAS t2)*

Bayes Factor for t-tests and ANCOVA models

BF_{10} for Independent Samples t-test were computed to assess the likelihood of H_1 (i.e., difference between PS group and control group anxiety levels) compared with H_0 and H_0 (i.e., no difference between PS group and control group anxiety levels) (see Table 2), to corroborate previous results from frequentist statistics (Wagenmakers et al., 2017). Children and mothers' preoperative anxiety (VAS t1) have BF_{10} between .33 and 1 presenting anecdotal evidence for H_0 (no difference between PS and controls). Fathers preoperative anxiety (VAS t1) has BF_{10} between 3 and 10 presenting substantial evidence for H_1 (difference between PS and controls). Children's postoperative anxiety (VAS t2) has BF_{10} between 10-30 indicating strong evidence for H_1 (difference between PS and controls). Mothers' postoperative anxiety (VAS t2) has BF_{10} >100 indicating a decisive evidence for H_1 (difference between PS and controls). Fathers' postoperative anxiety (VAS t2) has BF_{10} between .10 and .33 pointing out substantial evidence for H_0 (no difference between PS and controls). The interaction effects between group and time (from preoperative anxiety to postoperative anxiety) have BF_{10}>100 in children, mothers, and fathers, showing decisive evidence for H_1 (presence of the interaction effect) (Wagenmakers et al., 2017).

Tab. 2 - *Bayes Factors (BF10) of Independent Samples t-tests and ANCOVAs' time*group interactions effect on anxiety*

Independent Sample t-test (PS vs. Controls)	**BF_{10}**	**error %**
Child VAS t1	0.58	0.002
Child VAS t2	22.43	1.874e -4
Mother VAS t1	0.74	0.002
Mother VAS t2	1.518.38	6.639e -7
Father VAS t1	9.77	6.451e -4
Father VAS t2	0.24	0.011
Time*Group interaction effect	**BF_{10}**	**error %**
Child	257.846.092	13.359
Mother	1.295e +8	2.733
Father	33.998	3.520

Discussion

This study tested pre and post thoracoplasty anxiety of children and their parents in two conditions: the child experiencing vs. the child not experiencing the PS-based intervention. Since thoracoplasty is an invasive surgical intervention correcting pectus deformities in pediatric patients (Odell, 2012; Waters et al., 1989; Robicsek et al., 1979; Feng et al., 2001), it can elicit preoperative (Aranha et al., 2017; Jawaid et al., 2007; Moura et al., 2016; Kain et al., 1996; Kain & Mayes, 1996) and postoperative anxiety in the children (Kain et al., 1996; Kain et al., 1999; Kotiniemi et al., 1997) and also in their parents (Pomicino et al., 2018; Shirley et al. 1998; Thompson et al., 1996), negatively interfering with the child's recovery process and with the medical setting (Kampouroglu et al., 2020; Cothai et al., 2017). In light of evidence about PS-based intervention effectiveness in improving the child's wellbeing and counteracting anxiety towards medical environment and procedures (Gill, 2010; Moore et al., 2015; Li et al., 2016; Wong et al., 2018; Ullan & Belver, 2019), the present research is one pioneering study investigating whether PS-based intervention could impact anxiety levels before and after thoracoplasty. Alongside a study about the impact of telematic Play Specialist intervention (TPS) on parents of children with medical conditions (Perasso, Maggiore, Allegri & Camurati, 2020), this is one of the pioneering research focusing both on PS-based intervention's direct effect on the child and indirect effect on the parents.

The present findings show that children's and mothers' postoperative anxiety in the PS group is lower than the controls. This result can be explained in the light of the familiarization with the hospital environment provided by the PS-based intervention (Webster, 2000; Perasso et al., 2021, Sposito et al., 2016). A significant effect of time, before and after thoracoplasty, is reported in PS children, mothers, and fathers since their postoperative anxiety level is lower than preoperative. On the other hand, the controls exhibit opposite anxiety patterns with higher postoperative anxiety than preoperative. Differences between PS and controls and the interaction between time (from preoperative to postoperative anxiety) and group condition has been corroborated by Bayesian analyses (Wagenmakers, Verhagen, Ly, Matzke, Steingroever, Rouder et al., 2017). These results underline the importance of PS-based intervention in ameliorating recovery by diminishing negative emotions after the surgery. Overall, PS fathers' anxiety reduction effect size is minor than mothers' and children's which may be due to the fact fathers are less involved than the mother-child dyad in the hospital environment (e.g., institutional rules establishing that only one parent can assist the child). In line with previous literature addressing the need to provide fathers of children undergoing surgery with major support (Scrimin, Haynes, Atoe, Bornstein & Axia, 2009), this result encourages developing specific supporting interventions for paternal distress within the pediatric surgery ward. PS fathers presented higher preoperative anxiety than controls at research's baseline. Given random assignation of group condition to participants (PS vs. controls), this inter-group difference could be explained by individual differences in trait anxiety (Spieldberger, Goursuch, Lushene, 1970). Trait anxiety is determined by personality characteristics, differently from situational anxiety which is linked to life-events (Endler & Kocovski, 2001) (e.g., surgery). Nevertheless, PS fathers experienced a significant reduction of anxiety before-after the child's thoracoplasty.

No significant effects of covariates have emerged suggesting that the child's age and parents' age are not relevant factors influencing PS-based intervention's effect over time and the comparisons between PS families and controls. Overall, this research confirms the importance of PS in the hospital context (Dolan, 1993; Hart-Spencer & Griffiths, 2015), demonstrating the effectiveness of medical play (McCue, 1988) and activities leading the child to express his/her negative emotions in counteracting preoperative and postoperative anxiety.

The study presents three methodological limitations worth noticing. The first is the administration of only a self-report scale (i.e., VAS) for anxiety assessment, which could have distorted participants' responses for social desirability (Dicken, 1963). Thus, future research should deepen the

investigation of pre and post thoracoplasty anxiety levels with qualitative structured or semi-structured interviews. The second limitation is the absence of a follow-up procedure, which could have allowed to observe the long-term effects of PS on children and parents beyond 24 hours after thoracoplasty. This aspect should be taken into account because postoperative anxiety extends for two weeks after surgery in 54% of children and for six months after surgery in 20% of children (Kain et al., 1999). A future development of the research design could be implementing a six-months after follow-up to monitor postoperative anxiety in both PS families and controls longitudinally. The third limitation is the inter-groups difference at study's baseline (i.e., PS fathers presenting significantly higher preoperative anxiety than controls). Measuring and controlling the impact of trait anxiety is recommended for future research randomly assigning participants to the two group conditions (PS and controls).

Conclusion

The intervention based on PS practice successfully tempers the anxiety levels of children undergoing thoracoplasty and their parents. In fact, children provided with PS-based intervention and their mothers experience lower preoperative anxiety than controls. PS-based intervention also directly impacts on children by reducing the anxiety level from preoperative anxiety to postoperative anxiety and indirectly impacts on both parents to the same extent. These findings corroborate evidence around the beneficial influence of PS over hospitalized children and their families, and address Italian healthcare system with the need to recognize this professional figure at a national level as in other countries (e.g., UK) (Dolan, 1993, Perasso et al., 2021).

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