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Perioperative real-time information sharing and its impact on family members' anxiety in patients undergoing elective thoracoscopic lobectomy: a single-center randomized controlled trial

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Abstract

Objective This study aimed to evaluate the effect of perioperative real-time information sharing on family members' anxiety in patients undergoing elective thoracoscopic lobectomy and to explore the potential role of information sharing in reducing anxiety levels among family members.

Methods This study was a prospective, single-center, well-designed randomized controlled trial (RCT), ensuring methodological rigor, which included family members of patients undergoing elective thoracoscopic lobectomy. Participants were randomly assigned to either the experimental group (real-time information-sharing group) or the control group (routine information communication group). Anxiety levels were assessed at multiple time points, including preoperative (T-1), intraoperative (T1, T2, T3, T4), and postoperative (T5, T6) stages, using widely used anxiety scales: the Self-Rating Anxiety Scale (SAS), the Hospital Anxiety and Depression Scale (HADS), and the Generalized Anxiety Disorder 7 (GAD-7). Statistical analysis was performed using independent sample *t*-tests, with statistical significance set at $P < 0.05$ based on a predefined threshold.

Results At several key time points (T0, T1, T2, T3, T4, T5), family members in the experimental group showed significantly lower anxiety scores compared to those in the control group ($P < 0.05$). Notably, at T1 (when the patient entered the operating room) and T2 (30 min after the surgery began), the GAD-7 scores of the experimental group were significantly lower than those in the control group ($T = 2.98$, $P = 0.003$; $T = 3.45$, $P = 0.001$). The experimental group also had significantly lower SAS and HADS scores at time points T-1, T0, T1, T2, T3, and T4 compared to the control group.

Conclusion Perioperative real-time information sharing has been shown to significantly reduce anxiety levels in family members of patients undergoing elective thoracoscopic lobectomy, particularly during the early stages of surgery, such as when the patient enters the operating room and 30 min after the surgery begins. Real-time information sharing may serve as an effective intervention to improve the psychological well-being of family members and is worth promoting in clinical practice.

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Keywords Perioperative, Real-time information sharing, Thoracoscopic lobectomy, Family member anxiety, Randomized controlled trial

Background

Video-assisted thoracoscopic lobectomy (VATS) is a minimally invasive surgical technique that has become one of the standard treatments for lung cancer and other thoracic diseases. Due to its small incision, rapid recovery, and fewer postoperative complications, VATS has been widely adopted in clinical practice. However, family members' anxiety significantly impacts the perioperative course of patients. The emotional states of family members can not only impact the patient's psychological well-being and recovery but also affect postoperative compliance and overall treatment outcomes.

One study has shown that family members' anxiety is strongly associated with the patient's postoperative recovery speed, pain management, and overall treatment outcomes (Yang et al. 2021). Additionally, the emotional state of family members can affect the patient's sense of dependency on treatment and their level of cooperation, indirectly influencing the recovery process (Miller et al. 2019). Family members' anxiety directly impacts the patient's mood and postoperative recovery, especially in cases involving high surgical risks, where family members' anxiety may lead to increased patient unease, further complicating recovery (Wu et al. 2021). Statistics show that approximately 60% of family members of patients undergoing elective surgery experience moderate to severe anxiety during the perioperative period (Lee et al. 2022). In hospitals using traditional methods of communication, family member satisfaction tends to be low, and anxiety issues are often neglected. In contrast, hospitals utilizing real-time information-sharing technologies have reported a reduction in family members' anxiety levels by approximately 30% (Brown et al. 2023). Although VATS reduces physical pain for patients due to its minimally invasive nature, the uncertainties surrounding the surgery and the postoperative recovery process still contribute to family members' anxiety. Research has shown that family members' anxiety may have a negative association with the patient's prognosis, particularly in families under high social and psychological stress (Liu et al. 2020a). Therefore, effectively reducing family members' anxiety and providing real-time information support have become important research topics in perioperative management.

Recent studies have shown that digital technologies, particularly real-time information sharing, can effectively alleviate family members' anxiety (Xie et al. 2022; Wang et al. 2021). Real-time information sharing not only allows family members to stay informed about the patient's surgical progress and recovery status but also strengthens trust, reducing uncertainty before, during, and after surgery (Zhang et al. 2020). However, the specific effects of perioperative information sharing across different cultural contexts and surgical types have not been fully clarified. Existing studies mainly focus on anxiety interventions for patients, with relatively limited research on anxiety management for family members. Furthermore, ensuring timely and effective information delivery to family members during complex surgical procedures, while maintaining the accuracy and completeness of the information, remains a challenge.

This study aims to provide a novel intervention for reducing family members' anxiety and offer theoretical and practical support for future innovations in perioperative management models. Effective perioperative information sharing not only alleviates family members' anxiety but also enhances the patient's postoperative recovery, ultimately increasing satisfaction for both patients and their families. This approach offers more comprehensive and patient-centered perioperative support for patients undergoing thoracoscopic lobectomy.

The objective of this study is to explore the impact of perioperative real-time information sharing on family members' anxiety in patients undergoing elective thoracoscopic lobectomy. This research seeks to assess the role of real-time information sharing in reducing family members' anxiety, enhancing their trust in the surgery, and improving patient postoperative recovery.

Methods

Ethics and consent to participate statement

This study was approved by the Ethics Committee of West China Hospital, Sichuan University, China. Written informed consent was obtained from all participants prior to their inclusion in the study.

Study design and sample

This study adopted a well-designed randomized controlled trial (RCT) to ensure methodological rigor. The research was conducted from August 2023 to February 2024 in the thoracic surgery department at West China Hospital, Sichuan University, China.

Inclusion criteria

- American Society of Anesthesiologists (ASA) classification II-III

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \cdot (2 \cdot \sigma^2)}{d^2}$$

Fig. 1 Sample size calculation formula

- Age 18–70 years
- Able to understand and sign the informed consent form
- Family members of patients scheduled for elective thoracoscopic lobectomy
- Stable relationship between the family member and the patient, with the ability to provide valid anxiety assessment data
- Family members with a certain level of education and communication ability

Exclusion criteria

- Family members with severe mental illness or an inability to comprehend the study process.
- Previous participation in similar studies or interventions.
- Family members or patients with severe language or hearing impairments that affect information communication.
- Family members with special circumstances before or after the surgery (e.g., sudden serious illness, loss of family support).

Sample size calculation

To ensure statistical power and reliability of the study results, the Generalized Anxiety Disorder 7 (GAD-7) scale was selected as the primary outcome measure. It was assumed that there would be a significant difference in the reduction of anxiety levels between the experimental and control groups. Taking into account the effect size, significance level, and statistical power, the sample size was calculated (see Fig. 1). To compensate for potential dropouts or missing data, the sample size for each group was increased by approximately 20%. As a result, each group required about 75 participants, leading to a total of 160 participants in the study, with 80 participants in the experimental group and 80 participants in the control group.

Randomization

In this study, patients were randomly assigned to either the experimental group or the control group. The randomization was performed using a computer-generated random number table.

Allocation concealment and blinding

This study employed a single-blind design to minimize potential biases and subjective interference. Family members, data analysts, and some nursing staff were blinded to group assignment, reducing bias in the results. This approach allowed for an objective evaluation of the impact of perioperative real-time information sharing on family members' anxiety in patients undergoing elective thoracoscopic lobectomy. However, due to the nature of the intervention, both the family members and the research staff could not be fully blinded to the intervention (information sharing) since they were actively involved in it.

Data collection

At the beginning of the study, the research team collected general background information from both the patients and their family members, including patient demographics (gender, age), preoperative diagnosis, type of surgery, underlying diseases, length of hospital stay, and family member demographics (gender, age, relationship to the patient, education level, and socioeconomic status) on the day before surgery, based on the surgical schedule. All data were collected via questionnaires. The anxiety levels of the family members were assessed using the GAD-7, SAS, and HADS scales at eight different time points, which were as follows: T-1: the day before surgery; T0: 7:00 AM on the day of surgery; T1: upon entering the operating room (verified by the nurse scanning the patient's wristband barcode); T2: 30 min after the start of surgery; T3: upon leaving the operating room; T4: 8:00 PM on the day of surgery; T5: 1 day after surgery; T6: 7 days after surgery. Family satisfaction was measured using a satisfaction scale at T-1 and T6. Detailed information is provided in Table 1.

Experimental group

Family members of patients in the experimental group received perioperative real-time information-sharing interventions. For example, updates on surgical progress (e.g., "Surgery started at 10:30 AM"), patient condition ("Stable under anesthesia"), and estimated completion times were shared via SMS and a mobile app. Verbal updates were provided when necessary. The specific intervention process was as follows: On the day before surgery, the research team provided the experimental group families with relevant preoperative information, including basic details about the surgery and the expected postoperative recovery process. An information-sharing

Table 1 Time points and assessment tools

Time point	Assessment Content	Scales/tools used
T-1 (day before surgery)	General information, GAD-7, SAS, HADS, Family Satisfaction Scale	GAD-7, SAS, HADS, Family Satisfaction Scale
T0 (7:00 AM on the day of surgery)	Family anxiety assessment	GAD-7, SAS, HADS
T1 (upon entering the operating room)	Family anxiety assessment	GAD-7, SAS, HADS
T2 (30 min after surgery starts)	Family anxiety assessment	GAD-7, SAS, HADS
T3 (upon leaving the operating room)	Family anxiety assessment	GAD-7, SAS, HADS
T4 (8:00 PM on the day of surgery)	Family anxiety assessment	GAD-7, SAS, HADS
T5 (1 day after surgery)	Family anxiety assessment	GAD-7, SAS, HADS
T6 (7 days after surgery)	Family satisfaction assessment, anxiety assessment	GAD-7, SAS, HADS, Family Satisfaction Scale

Abbreviations: *GAD-7* Generalized Anxiety Disorder Scale-7, *SAS* Self-Rating Anxiety Scale, *HADS* Hospital Anxiety and Depression Scale

channel (such as QQ, WeChat, or email) was established, and the research team informed the family members about the real-time information-sharing process during surgery. The real-time status of the patient's surgery at four key time points (entering the operating room, start of surgery, end of surgery, and return to the ward) was collected from the anesthesia management system. This data was uploaded to a platform and integrated, then pushed to the family member's mobile phone. Family members were also informed about the patient's postoperative care plan and precautions via phone calls or text messages.

Control group

Family members in the control group did not receive the real-time information-sharing intervention. Instead, they received only the routine preoperative information and postoperative guidance.

Generalized Anxiety Disorder 7 (GAD-7) Scale (Spitzer et al. 2006)

The GAD-7 scale, developed by Spitzer in 2006, is a brief and efficient self-report tool designed to assess anxiety symptoms and categorize their severity. It consists of 7 items that evaluate anxiety symptoms over the past two weeks, with responses ranging from 0 (not at all) to 3 (nearly every day). The total score ranges from 0 to 21. The GAD-7 has demonstrated excellent reliability (Cronbach's $\alpha > 0.89$) and construct validity across various cultural contexts. It has also been widely used in perioperative research settings, ensuring its relevance and applicability to the present study (Liang et al. 2011).

Self-Rating Anxiety Scale (SAS) (Zung 1971)

The SAS, developed by Zung in 1971, is a commonly used self-assessment tool to evaluate anxiety levels in family members. This scale was used to compare the anxiety scores of family members in the experimental group (real-time information sharing) and the control group (routine care) to assess the impact of information sharing on family members' anxiety. The SAS consists of 20 items rated on a Likert scale from 1 (rarely) to 4 (often), with a total score ranging from 20 to 80. Higher scores indicate more severe anxiety. The SAS has shown high internal consistency (Cronbach's $\alpha = 0.91$) and good discriminative validity, particularly in Chinese populations, making it a reliable and robust tool for this study (Wang and Li 1983).

Hospital Anxiety and Depression Scale (HADS) (Zigmond and Snaith 1983)

The HADS, developed by Zigmond and Snaith in 1983, includes 14 items, 7 of which assess anxiety and 7 assess depression. Each item is scored from 0 to 3, with the total score ranging from 0 to 21. A higher score indicates greater severity of anxiety or depression. The HADS has consistently demonstrated strong psychometric properties in hospital settings, with Cronbach's α values for its anxiety subscale exceeding 0.8. Its widespread use in studies involving hospitalized patients and their families further supports its validity and reliability in this research context (Liu and Ma 2001).

Family Satisfaction Scale (Tripp and Flanagan 1990)

The Family Satisfaction Scale, developed by Tripp and Flanagan in 1990, is designed to assess family members' overall satisfaction with healthcare services. The scale consists of 10–15 items evaluating family members' satisfaction with various aspects of the patient's hospitalization, including communication with doctors and nurses, treatment effectiveness, quality of care, and the hospital environment. Each item is rated from 1 (very dissatisfied) to 5 (very satisfied), with higher total scores indicating greater family satisfaction. The scale has been widely validated in Chinese settings,

demonstrating high internal consistency (Cronbach's $\alpha = 0.89$), which ensures the reliability of satisfaction assessments in this study (Zhang and Wang 2010).

Study outcomes

The primary outcome of this study is to investigate the impact of perioperative real-time information sharing on anxiety levels in family members of patients undergoing elective thoracoscopic lobectomy.

The secondary outcome of this study is to analyze the effects of real-time information sharing on family members' emotional support and satisfaction.

Statistical analysis

Data analysis was performed using the SPSS 22.0 software package. Categorical variables were expressed as absolute and relative frequencies, while continuous variables were presented as means and standard deviations, according to whether they followed a normal or non-normal distribution. Independent sample *t*-tests were used to compare anxiety levels between the experimental and control groups at preoperative, intraoperative, and postoperative time points. Chi-square tests were employed to examine the relationship between categorical variables and group variables. When anxiety was considered an ordered categorical variable, the Mann–Whitney *U* test was used to compare outcomes between the two groups. A significance level of 5% was considered. A significance threshold of $P < 0.05$ was chosen based on conventional statistical standards to minimize type I errors while ensuring sufficient statistical power. Missing data were handled using multiple imputation techniques to reduce bias and enhance the robustness of the findings, with sensitivity analyses conducted to ensure the consistency of results across different assumptions.

Results

A total of 160 patients were enrolled in the study. Three patients were excluded (1 patient was transferred to ICU and 1 patient withdrew; 1 case was lost to follow-up), leaving 157 patients for analysis (Fig. 2), with 78 patients in the control group and 79 in the experimental group. The demographic characteristics of the experimental and control groups were similar (Table 2).

Comparison of GAD-7 scores between the two groups

The results showed that the experimental group had significantly lower GAD-7 scores at several key time points (T0, T1, T2, T3, T4, and T5) compared to the control group, with statistically significant differences ($P < 0.05$). Notably, at T1 and T2, the GAD-7 scores in the experimental group were significantly lower than those in the control group ($T = 2.98$, $P = 0.003$ and $T = 3.45$, $P = 0.001$). However, at T5 and T6, the differences between the two groups were not statistically significant ($P > 0.05$). These results are summarized in Table 3.

Comparison of SAS scores between the two groups

The experimental group had significantly lower SAS scores at the following time points: T-1, T0, T1, T2, T3, and T4, compared to the control group ($P < 0.05$). These results are summarized in Table 4.

Comparison of HADS scores between the two groups

The experimental group had significantly lower HADS scores at the following time points: T-1, T0, T1, T2, T3, T4, and T5, compared to the control group ($P < 0.05$). These results are summarized in Table 5.

Comparison of Family Satisfaction Scale (FSS) scores

On the day before surgery (T-1), there were no significant differences in the family satisfaction scores between the intervention group and the conventional group ($P > 0.05$). However, 7 days after surgery (T6), the family satisfaction scores in the intervention group were significantly higher than those in the conventional care group ($P < 0.05$), as shown in Table 6. This suggests that perioperative real-time information sharing has a significant effect on improving family satisfaction.

In the later stage of the study, we retrospectively analyzed postoperative data to assess the impact of real-time information sharing. The intervention group had a significantly shorter hospital stay compared to the control group (4.1 ± 0.9 vs. 4.4 ± 1.2 days, $P = 0.041$). However, no significant difference was observed in postoperative complication rates (15.2% vs. 18.9%, $P = 0.420$). Detailed results are shown in Table 7.

Discussion

The results of this study show that the real-time information-sharing system greatly reduces the anxiety of family members. Our findings revealed that the experimental group had notably lower anxiety scores at several key time points (T1, T2) compared to the control group. This effect was particularly pronounced during high-anxiety periods, such as the preoperative (T-1) and intraoperative phases (T1, T2). Real-time information sharing, which included updates on the surgical progress, patient status, and postoperative recovery, helped reduce the uncertainty and worry experienced by family members, enhancing their emotional stability. These results are consistent with previous studies, such as those by Wang et al. (2021), which demonstrated that real-time updates

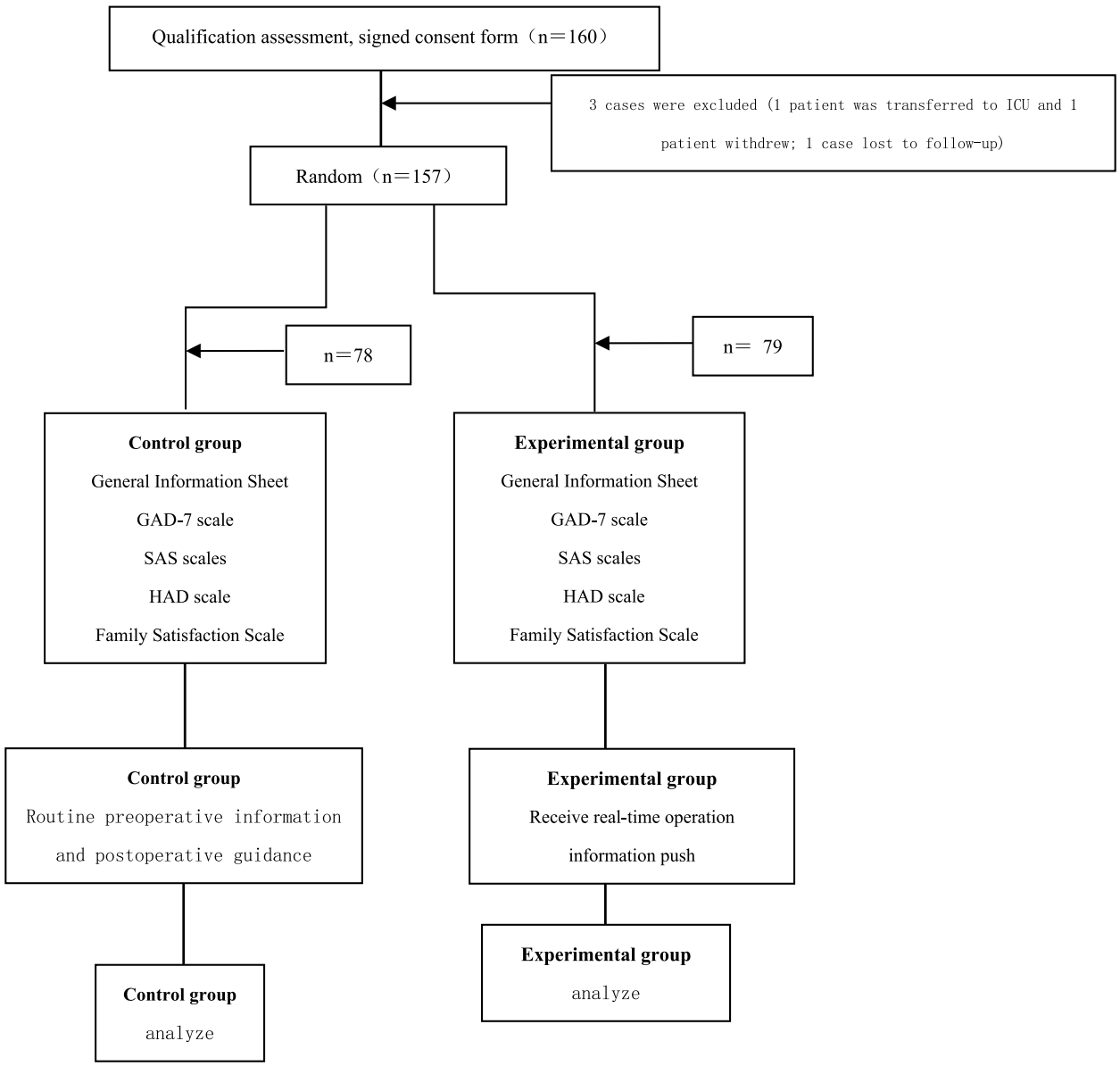

Fig. 2 Study flow diagram

on the patient's condition can significantly reduce family members' anxiety, particularly during the surgery itself.

As the postoperative period progressed, anxiety levels gradually decreased, and the effect of information sharing diminished. By T5 (1 day after surgery) and T6 (7 days after surgery), the differences between the two groups were no longer statistically significant ($P > 0.05$). This suggests that the impact of real-time information sharing is most prominent before and during the surgery, with its influence gradually weakening during the recovery phase. At key time points such as T-1, T0, T1, T2, T3, and T4, anxiety scores in the experimental group were consistently lower than those in the control group. However, during the postoperative phase, anxiety levels are influenced not only by the patient's recovery but also by unforeseen complications and uncertainties about treatment outcomes, which may explain the lack of significant improvement in the short term (Huang et al. 2019). Nonetheless, early postoperative information sharing can still provide emotional support and help family members better manage their anxiety, especially when they are kept informed about the patient's recovery progress.

The effectiveness of information sharing in reducing family members' anxiety is closely related to how the

Table 2 Demographic characteristics

Characteristic	Group	Sample size ($N=157$)	Control group ($n=78$)	Experimental group ($n=79$)	*P*-value
Patient gender	Male	89 (56.7%)	45 (57.7%)	44 (55.7%)	0.85
	Female	68 (43.3%)	33 (42.3%)	35 (44.3%)	
Patient age (years)	Mean ± SD	58.4 ± 10.3	58.6 ± 10.2	58.2 ± 10.5	0.92
Preoperative diagnosis	Lung cancer	106 (67.5%)	55 (70.5%)	51 (64.6%)	0.56
	Benign pulmonary tumor	51 (32.5%)	23 (29.5%)	28 (35.4%)	
Surgical procedure	Wedge resection	137 (87.3%)	68 (87.2%)	69 (87.3%)	0.99
	Segmentectomy	20 (12.7%)	10 (12.8%)	10 (12.7%)	
Comorbidities	Hypertension	50 (31.9%)	27 (34.6%)	23 (29.1%)	0.63
	Diabetes	35 (22.3%)	17 (21.8%)	18 (22.8%)	0.88
	Coronary heart disease	23 (14.6%)	11 (14.1%)	12 (15.2%)	0.94
	No comorbidities	49 (31.2%)	23 (29.5%)	26 (32.9%)	0.72
Hospital stay (days)	Mean ± SD	4.2 ± 2.4	4.3 ± 2.5	4.1 ± 2.3	0.73
Family gender	Male	68 (43.3%)	38 (48.1%)	30 (38.0%)	0.18
	Female	89 (56.7%)	41 (51.9%)	49 (62.0%)	
Family age (years)	Mean ± SD	52.1 ± 12.3	51.7 ± 11.9	52.5 ± 12.7	0.67
Relationship to patient	Spouse	87 (55.4%)	43 (55.1%)	44 (55.7%)	0.97
	Child	35 (22.3%)	15 (19.2%)	20 (25.3%)	0.42
	Other	35 (22.3%)	20 (25.6%)	15 (19.0%)	0.58
Educational level	High school or below	101 (64.3%)	51 (65.4%)	50 (63.3%)	0.82
	College or higher	56 (35.7%)	27 (34.6%)	29 (36.7%)	
Annual family income	> 250,000	59 (37.6%)	28 (35.9%)	31 (39.2%)	0.95
	150,000–250,000	77 (49.0%)	38 (48.7%)	39 (49.4%)	
	< 150,000	21 (13.4%)	12 (15.4%)	9 (11.4%)	

information is delivered. In traditional surgical settings, family members often rely on verbal updates from healthcare providers or limited written materials, which are often delayed and prone to misinterpretation, further exacerbating anxiety (Li et al. 2020). In contrast, real-time information sharing, facilitated by digital platforms or other technological means, provides family members with timely and accurate updates, enhancing information transparency and reducing feelings of uncertainty and anxiety (Zhou et al. 2021). This aligns with previous studies, which have demonstrated that the introduction of digital information platforms or surgical monitoring systems can significantly improve family members' emotional responses, increasing their trust in the medical process and overall satisfaction. Real-time information sharing reduces family members' anxiety by minimizing the unknowns and uncertainties surrounding the surgical process. Previous research has highlighted information asymmetry as a major contributor to family members' anxiety (Liu et al. 2020b). When family members are kept informed about the progress of the surgery, the patient's condition, and any potential changes during the procedure, their psychological burden is effectively reduced. This is especially important in complex surgeries like thoracoscopic lobectomy, where smooth information flow helps family members feel more in control and less anxious (Chang et al. 2018). Additionally, real-time updates on postoperative recovery further help family members understand the recovery process and expectations, enabling them to face the recovery phase with a more positive mindset (Hoffman et al. 2019). The inclusion of real-time feedback mechanisms, such as brief post-surgery surveys, demonstrated that family members found the updates helpful in managing their stress levels.

The observed differences in hospital stay duration between the experimental and control groups should be interpreted with caution, as several potential confounding factors may have contributed to these variations. Variations in patient comorbidities, the complexity of surgical procedures, and individual differences in recovery rates are likely to have contributed to these differences. Additionally, factors such as perioperative complications, the level of postoperative care received, and patients' adherence to rehabilitation protocols could have further impacted hospital stay duration. A comprehensive evaluation of these factors is essential to accurately interpret the results and to better understand the potential benefits of real-time information sharing in perioperative management.

Table 3 Comparison of GAD-7 scores between the two groups (Mean ± SD)

Time point	Control group ($n=78$)	Experimental group ($n=79$)	*P*-value
T-1 (day before surgery)	15.4 (± 3.2)	12.6 (± 2.9)	0.034
T0 (7:00 AM on the day of surgery)	16.2 (± 3.5)	13.8 (± 3.0)	0.061
T1 (upon entering the operating room)	17.0 (± 4.0)	14.3 (± 3.1)	0.003
T2 (30 min after surgery starts)	15.5 (± 3.3)	12.8 (± 2.7)	0.001
T3 (Upon leaving the operating room)	14.0 (± 3.1)	12.0 (± 2.5)	0.008
T4 (8:00 PM on the day of surgery)	13.2 (± 2.8)	11.4 (± 2.3)	0.014
T5 (1 day after surgery)	12.5 (± 2.7)	11.1 (± 2.2)	0.085
T6 (7 days after surgery)	10.8 (± 2.5)	9.4 (± 2.0)	0.183

Table 4 Comparison of SAS scores between the two groups (Mean ± SD)

Time point	Control group ($n=78$)	Experimental group ($n=79$)	*P*-value
T-1 (day before surgery)	53.0 (± 6.2)	49.8 (± 5.3)	0.039
T0 (7:00 AM on the day of surgery)	54.8 (± 6.5)	51.2 (± 5.7)	0.027
T1 (upon entering the operating room)	57.5 (± 7.0)	51.0 (± 6.3)	0.001
T2 (30 min after surgery starts)	55.2 (± 6.8)	50.0 (± 5.6)	0.005
T3 (upon leaving the operating room)	53.0 (± 6.1)	49.2 (± 5.2)	0.021
T4 (8:00 PM on the day of surgery)	52.5 (± 5.7)	50.0 (± 5.0)	0.151
T5 (1 day after surgery)	51.0 (± 5.4)	48.2 (± 4.8)	0.049
T6 (7 days after surgery)	49.8 (± 5.3)	48.0 (± 4.7)	0.255

Table 5 Comparison of HADS scores between the two groups (Mean ± SD)

Time point	Control group ($n=78$)	Experimental group ($n=79$)	*P*-value
T-1 (day before surgery)	10.5 (± 3.2)	9.0 (± 2.9)	0.042
T0 (7:00 AM on the day of surgery)	11.2 (± 3.4)	9.5 (± 3.1)	0.021
T1 (upon entering the operating room)	12.0 (± 3.8)	9.8 (± 3.2)	0.003
T2 (30 min after surgery starts)	11.4 (± 3.6)	9.5 (± 3.0)	0.010
T3 (upon leaving the operating room)	10.8 (± 3.1)	9.2 (± 2.7)	0.037
T4 (8:00 PM on the day of surgery)	10.2 (± 3.0)	8.5 (± 2.8)	0.030
T5 (1 day after surgery)	9.8 (± 2.9)	8.3 (± 2.6)	0.115
T6 (7 days after surgery)	8.6 (± 2.5)	8.0 (± 2.3)	0.324

Table 6 Comparison of Family Satisfaction Scale scores between the two groups

Time point	Control group ($n=78$)	Experimental group ($n=79$)	*P*-value
T-1 (day before surgery)	14.12 ± 3.11	14.20 ± 3.06	0.851
T6 (7 days after surgery)	15.40 ± 3.10	17.50 ± 2.74	< 0.01

Despite the significant benefits of real-time information sharing in reducing anxiety among family members of patients undergoing elective thoracoscopic lobectomy, its implementation presents several challenges. These include the need for substantial technical support and financial investment, which can be particularly difficult for resource-limited healthcare settings, potentially hindering widespread adoption. Cultural differences, varying education levels, and differing levels of technological acceptance among family members also affect the system's effectiveness. Personalized approaches, such as simplified user interfaces or alternative communication

Table 7 Comparison of postoperative data between the intervention and control groups

Postoperative indicators	Control group ($n=78$)	Intervention group ($n=79$)	*P*-value
Length of hospital stay (days)	4.4 ± 1.2	4.1 ± 0.9	0.041
Incidence of complications	18.9% (15/78)	15.2% (12/79)	0.420

methods like verbal updates, are crucial to optimizing these interventions. Moreover, ensuring compliance with privacy regulations, such as GDPR and HIPAA, is essential to address data security concerns and maintain transparency. Future research should focus on identifying the most effective communication methods, such as text messages, video calls, or scheduled updates, to meet the diverse needs of family members. Additionally, large-scale, multicenter randomized controlled trials are needed to evaluate the cost-effectiveness, scalability, and long-term impact of these systems, ultimately facilitating their broader adoption and transforming perioperative care.

Conclusion

Perioperative real-time information sharing is an effective intervention for reducing anxiety among family members of patients undergoing elective thoracoscopic lobectomy, particularly at key time points such as the day before surgery, during surgery, and in the early postoperative period. By reducing uncertainty regarding the patient's condition, real-time information sharing provides psychological support and reassurance to family members. In the future, combining various information dissemination methods and technologies, real-time information sharing holds the potential for broader clinical application, ultimately enhancing the psychological well-being of patients' families.

Abbreviations

RCT	Randomized controlled trial
VATS	Video-assisted thoracic surgery
ASA	American Society of Anesthesiologists
GAD-7	Generalized Anxiety Disorder Scale
SAS	Self-Rating Anxiety Scale
HADS	Hospital Anxiety and Depression Scale
GAD-7	Generalized Anxiety Disorder Scale-7
SAS	Self-Rating Anxiety Scale
HADS	Hospital Anxiety and Depression Scale

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Authors' contributions

YLJ was the principal designer of the study, responsible for the overall conception, design, implementation, data collection, and analysis, and wrote the first draft of the manuscript. LX contributed to the study design, data collection, and organization, and played a key role in writing and revising the manuscript, particularly the results section. YYM participated in the design of the study, handled patient recruitment and follow-up, provided data support, and made significant revisions to the manuscript. LWLJ conducted statistical analysis and assisted in writing and revising the statistical methods section. YL assisted in the research design, carried out certain experimental procedures, and contributed to data analysis and manuscript writing. KJP managed some of the cases, collected patient information, assisted with data organization, and participated in manuscript revision. FLJ was involved in the implementation of the study, provided technical support, assisted in data collection and analysis, and reviewed the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical guidelines outlined in the *Declaration of Helsinki* by the World Medical Association and the *Regulations for Ethical Review of Biomedical Research Involving Humans* issued by the National Health and Family Planning Commission of the People's Republic of China. The study was approved by the Ethics Committee of West China Hospital, Sichuan University (Approval No. 2022–389, dated April 29, 2022), and was registered with the Chinese Clinical Trial Registry (Registration No. ChiCTR2300074573, dated October 8, 2023) (http://www.chictr.org.cn). The first group of participants was enrolled on August 19, 2023, and the trial was retrospectively registered on August 21, 2023. All participants and their family members were informed about the study and signed an informed consent form prior to surgery. A dedicated researcher explained the study's purpose, procedures, and potential risks in a private setting, allowing ample time for questions before consent was obtained.

Competing interests

The authors declare no competing interests.

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