

Immediate postoperative fever in a patient with scoliosis: Case report and literature review

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Case Report

Keywords: Postoperative Fever, Scoliosis, General Anesthesia, Hypothermia, Blood Transfusion

Posted Date: May 13th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1618391/v1>

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Abstract

Background: Fever is a common clinical symptom in patients with postoperative scoliosis. However, there are rare reports of fevers occurring immediately following operative procedures.

Case presentation: A 15-year-old female with a 1-year history of scoliosis was admitted to the hospital after a health examination. The patient was diagnosed with idiopathic scoliosis and underwent a posterior idiopathic scoliosis procedure and correction for pedicle fixation. Clinical symptoms, including chills, fever, increased heart rate and increased blood pressure, were observed immediately following surgery during anesthesia recovery. However, this study did not monitor for temperature-change data over time during the whole intraoperative period. The patient was discharged 12 days after the operation, and no chills or fever ($\geq 38^{\circ}\text{C}$) occurred during the 90-day follow-up, and no delayed infection during the over three years of follow-up. A systematic review of the literature on this subject was performed.

Conclusions: Immediate postoperative fever may be a self-limiting or self-regulating process in patients with scoliosis. The treatment intervention should be circumspect when patients experience such symptoms without clinical evidence because they may not have serious outcomes. Our case provides insufficient clinical evidence to determine whether this condition is due to transfusion reaction, or anesthesia inhibition.

Background

Postoperative fever is a common clinical symptom in patients with scoliosis, with an incidence ranging from 33.3–72% [1–4]. The most frequently observed cause of fever is surgical trauma, which is associated with inflammatory responses to surgery, and such fevers typically resolve within 2–3 days [1, 5]. However, there are rare reports of chills and fevers occurring immediately following spinal surgery; to the best of our knowledge, there have been no reports on the mechanism of immediate postoperative fever following spinal surgery. We present a case of a patient who underwent posterior idiopathic scoliosis incision and correction for pedicle fixation; immediately occurring fevers were observed during the anesthesia recovery period following the operative procedures.

Case Presentation

History and examination

A 15-year-old female with a 1-year history of scoliosis was admitted to the hospital after a health examination. A radiograph of the patient's spine revealed progressive double thoracic scoliosis with main right convex thoracic scoliosis from T2 to L1 of 50° , with its apex at T8, and left convex upper thoracic scoliosis from T8 to S1 of 35° (Fig. 1). There was no family history of spinal or chronic disease.

Operative procedure

Preoperative patient preparation includes anesthesia assessment, blood preparation and autologous blood recovery transfusion. The operating room temperature and humidity should be set to $24 \pm 2^{\circ}\text{C}$ and 60%, respectively. General anesthesia for patients requires tracheal intubation using an endoscope. Sufentanil, etomidate, and midazolam represent suitable means to induce anesthesia, and atracurium, propofol and fentanyl are used to maintain anesthesia (Fig. 2). The patient lies in a prone position. Then, the skin is disinfected using a 2% tincture of iodine and 75% alcohol. To avoid damaging the spinal cord during dorsal T2–T9 correction using titanium implants, spinal cord function is monitored during the surgery. Normal saline is used to flush the wound following the orthopedic incision on the spine, and one drainage tube is inserted into the operative incision. In our case, the operation time was 6 h 10 min, and the duration of anesthesia was 6 h 50 min. Intraoperative bleeding amounted to approximately 1000 ml, the transfused quantity of allogeneic concentrated red blood cells was 1.5 μ (300 ml), and the autologous blood recovery transfusion totaled 750 ml. The intraoperative vital signs were stable, and the evoked potential spinal cord monitoring was normal (Fig. 2).

Postoperative symptoms, intervention measures and outcome

The clinical symptoms of interest, including chills, fever, increased heart rate and increased blood pressure, were observed immediately during anesthesia recovery. The highest patient temperature reached 39.4°C, the increased heart rate reached 146 beats per minute (91 preoperatively), and the increased blood pressure reached 190/89 mm/Hg (125/78 preoperatively). The patient was escorted back to the ward at 2 h postoperatively (her temperature was 38.8°C, her heart rate was 128 beats per minute, and her blood pressure was 140/62 mm/Hg), during which time the patient's vital signs were monitored (Fig. 2). At 22:00 on the same day (3 h postoperatively), the patient began sweating, and her body temperature decreased to the normal level (Fig. 2).

The intervention measures included the administration of 10 mg dexamethasone by intravenous injection, convective warming of the patient, and accelerated liquid infusion using compound sodium chloride. The patient was then transferred to the postanesthesia care unit for close monitoring and conservative management.

During the recovery period in the ward, the intervention measures included treatment for infection, dehydration, hormones, pain relief, stomach care, and circulation improvement, as well as dressing changes; the postoperative recovery was smooth (Fig. 3). A review of the radiograph of the spine revealed that the position of the internal fixator was good, and the scoliosis was significantly improved. The patient was discharged 12 days after the operation, and no surgery-associated delayed infections were noted during the over three years of follow-up.

Literature review

We conducted a search according to the PICOS approach: patients (scoliosis or spinal), intervention (spinal fusion or pedicle screws), comparison (no limitation), outcome (fever), and study (no limitation) (search strategy see Supplementary Appendix S1-S3 and Appendix Figure S1). We searched the following databases: PubMed-MEDLINE, Ovid-EMBASE and Cochrane-CENTRAL. The search was conducted on November 1, 2021, and identified 362 citations. Title and abstract screening identified 18 eligible citations (Table 1). Full text screening identified one eligible citation that described immediate postoperative fever in scoliosis or spinal patients [6], which was a retrospective observational study reporting that 22 patients (11%) in whom postoperative cell salvage was used experienced fever (> 38.3°C) or a chilly sensation immediately after the reinfusion of blood procured by postoperative cell salvage in 321 spinal surgeries without scoliosis (see Supplementary Appendix Figure S1).

Table 1

Literature review of postoperative fever in patients with non-delayed infections of spinal surgery.

Author	Year	Study type	Participant	Sample size	Postoperative fever	Immediate postoperative fever	Major outcome
Stricsek GP[29]	2021	Retrospective observational study	Posterior lumbar spinal fusion	107	41.1% (44/107)	No description	The number of tests per patient increase with the range of temperatures analyzed ($P < 0.01$), but the rate of readmission of all the 4 groups are not significantly different (0.107). There is no significant difference in the number of febrile episodes per day between patients who were and who were not readmitted (0.209).
Faldini C[30]	2021	Case series	Scoliosis	3	33.3% (1/3)	No (post-operative day 2)	In conclusion, posterior spinal fusion with high-density pedicle screw systems and direct vertebral rotation may be safe and effective in surgical correction of scoliosis in Ullrich Congenital Muscular Dystrophy. If pelvic obliquity and L5-tilt are less than 15° , could be possible to achieve an optimal spinal and pelvic balance even without sacral or pelvic fixation.
Chae HJ[31]	2021	Retrospective observational study	Spinal epidural abscess	23	26.1% (6/23)	Non	Spinal epidural abscess accompanied by bacteremia required a longer duration (> 8 weeks) of antibiotic treatment.

Author	Year	Study type	Participant	Sample size	Postoperative fever	Immediate postoperative fever	Major outcome
Hwang CJ[7]	2020	Retrospective observational study	lumbar or thoracic spinal instrumentation	598	11.4% (68/598, sustained fever)	No description	Although most patients with sustained fever did not have surgical site infection, fever was significantly related to surgical site infection.
Yousef MAA[3]	2018	Retrospective observational study	Neuromuscular scoliosis	76	64.5% (49/76)	No description	Sixty-four percent of patients who underwent surgical correction of neuromuscular scoliosis developed postoperative fever. Postoperative fever was sign of infection in 32.7% of patients and urinary tract infection was the most frequent finding. Only 15.2% of fever diagnostic workup tests were positive. Diagnostic urine tests account for 70% of the positive diagnostic workup. The routine use of blood cultures for the assessment of postoperative fever in such population should be avoided due to the low rate of positive tests and the associated high cost.

Author	Year	Study type	Participant	Sample size	Postoperative fever	Immediate postoperative fever	Major outcome
Yousef MAA[3]	2018	Retrospective observational study	Scoliosis	76	64.5% (49/76)	Non	Sixty-four percent of patients who underwent surgical correction of neuromuscular scoliosis developed postoperative fever. Postoperative fever was sign of infection in 32.7% of patients and urinary tract infection was the most frequent finding.
Seo J[1]	2017	Retrospective observational study	Spinal surgery (without scoliosis)	250	13.2% (33/250)	No description	There were 33 febrile patients and 217 afebrile patients. Multivariate logistic regression showed that surgical approach (i.e., posterior approach with anterior body removal and mesh graft insertion), trauma, tumor surgery comparing degenerative disease, and long duration of surgery were statistically significant risk factors for postoperative nonpathological fever.
Elsamadicy AA[32]	2017	Retrospective observational study	Spinal fusion	874	3.7% (32/874)	No description	This study suggests that patients undergoing spinal fusion with laminectomy may have higher complication rates than patients undergoing spinal fusion alone.

Author	Year	Study type	Participant	Sample size	Postoperative fever	Immediate postoperative fever	Major outcome
Nishnianidze T[33]	2016	Retrospective observational study	Posterior spinal fusion	303	44.2% (139/303)	No description	Postoperative fever, seizures, and septicemia were associated with higher preoperative risk score.
Gornitzky AL[34]	2016	Retrospective observational study	Adolescent idiopathic scoliosis	138	No description	No description	Implementation of standardized rapid recovery pathway resulted in reduced pain, faster mobilization, reduced frequency of opioid-related sideeffects, and earlier discharge.
Lam SK[8]	2015	Cross-sectional study	Spinal fusion	9538	4.2% (402/9538)	No description	Higher transfusion rates were observed in patients with complications of fever and hematoma but not wound infection.
Blumstein GW[4]	2015	Retrospective observational study	Scoliosis	278	72% (201/278)	No description	Seventy-two percent (201/278) of patients had $T_{max} \geq 38^{\circ}\text{C}$ in the postoperative period (0–7) and 9% (27/278) had $T_{max} \geq 39^{\circ}\text{C}$. Of the patients that were, and 1% (2/214) had $T_{max} \geq 39^{\circ}\text{C}$ after postoperative hospitalized for more than 4 days, 14% (31/214) had $T_{max} \geq 38$ day 4.

Author	Year	Study type	Participant	Sample size	Postoperative fever	Immediate postoperative fever	Major outcome
Rollins MD[13]	2012	Case report	Spine surgery	2	100% (2/2)	No description	Two cases highlight the importance of vigilant investigation in patients suspected of transfusion-related acute lung injury, as septic transfusions are easily missed and may mimic or coexist with transfusion-related acute lung injury.
Walid MS[35]	2011	Retrospective observational study	Spine surgery	578	41.7% (241/578)	No description	Postoperative fever in spine surgery patients is associated with a delay in patient discharge and increases in hospital charges. Postoperative fever discharge guidelines should be regularly and publicly subjected to appropriate cost-benefit analysis.
Park MS[36]	2006	Retrospective observational study	Spinal fusion surgeries	62	62.9% (39/62)	No description	Homologous transfusion was associated with an increased number of total units transfused, longer duration of fever, and decreased patient satisfaction regarding the transfusion.

Author	Year	Study type	Participant	Sample size	Postoperative fever	Immediate postoperative fever	Major outcome
Park KS[6]	2004	Retrospective observational study	Spinal surgery	321	10.0% (32/321)	10.7% (22/204) in post-operative cell salvage; 12.0% (10/83) in homologous transfusion	Twenty-two patients (11%) in whom post-operative cell salvage was used suffered from fever (> 38.3°C) or a chilly sensation immediately after the reinfusion of blood procured by post-operative cell salvage.
Osebold WR[37]	1993	Case report	Idiopathic scoliosis	2	100% (2/2)	Non	Initial symptoms and signs were nonspecific; appropriate treatment had to begin before diagnosis could be confirmed by stool toxin assay, which requires 2 days.
Triulzi DJ[38]	1992	Retrospective observational study	Spinal surgery	109	No description	No description	These data strongly implicate allogeneic transfusion as a risk factor for in-hospital postoperative bacterial infection.
Torline RL[39]	1992	Case report	kyphoscoliosis	1	100% (1/1)	Non	This case illustrates extreme fever with central anticholinergic syndrome in association with a clinical dose of scopolamine.

Discussion And Conclusions

Immediate postoperative fever following scoliosis surgery is rarely reported in the literature, which focuses predominantly on infectious [3, 7] and noninfectious [1, 4, 8] postoperative fevers occurring 24 to 72 h after surgery. The risk factors, treatments and prevention of immediate fevers in postoperative patients require analysis.

Postoperative fever presents as an increased body temperature higher than 38°C and is considered a common event that might complicate postoperative treatment [9]; there may not be an association between atelectasis and fever [10]. Increasing evidence indicates that postoperative fever is an inflammatory response to surgical trauma to tissue resulting from the release of cytokines, such as interleukins 1 and 6, tumor necrosis factor- α , and interferon- γ , which affect the thermoregulatory

mechanism at the hypothalamus; nevertheless, infection is an uncommon cause of postoperative fevers following posterior spinal fusion [4, 5]. The metabolic rate at which organisms transform energy and materials is largely governed by the Boltzmann factor, which describes the temperature dependence of biochemical processes, and the quarter-power allometric relation, which describes how biological rate processes are scaled according to body size [11]. However, despite these indicators, when patients develop postoperative fevers, nearly all surgeons seek to rule out the possibility of an infection [7, 12]. In our case, there were clinical symptoms of immediate chills and fevers, but there was no evidence of a preoperative or postoperative inflammatory response to bacterial infection from any source during the over three-year follow-up period. We ruled out the possibility of an acute intraoperative infection or delayed infections, which may involve transfusion-related acute lung injury or septic transfusions [13, 14], as well as clinical symptoms with any suspected infection [15].

After ruling out an infection during the acute phase of a fever, the physician treating a patient with fever should consider the duration of the surgery and the inflammatory response that may be caused by surgical tissue trauma [5]. An observational study found that nonpathological fevers commonly occurred 6.5 ± 3.01 days postoperatively [1]. This evidence is not consistent with the case presented here. Therefore, we ruled out the possibility of a traumatic inflammatory response.

Intraoperative autologous transfusion may result in hemolysis during collection and hemoglobinuria and coagulation abnormalities after transfusion according to a two-case report from a previous study [16], and a retrospective observational study reported that 11% of patients in whom postoperative cell salvage was used experienced fever ($> 38.3^\circ\text{C}$) or a chilly sensation immediately after the reinfusion of blood procured by postoperative cell salvage in 321 spinal surgeries without scoliosis [6]. In our case, 750 ml and 300 ml of blood were transfused from intraoperative autologous and homologous transfusion, respectively, but there were no signs of hemolysis, hemoglobinuria or coagulation abnormalities following the transfusion. Although the intraoperative autologous blood was washed to separate red blood cells before reinfusion [17], it was reported that autologous blood was uniquely associated with a fever reaction in 11% of the patients receiving postoperative cell salvage rather than intraoperative autologous transfusion [6]. Therefore, we could not rule out the possibility that these symptoms are due to transfusion reactions.

General anesthesia is considered to impair thermoregulation and to synchronously reduce the thresholds for vasoconstriction and shivering [18]. Thermoregulation is inhibited to varying degrees during general anesthesia [19]. The effect of general anesthesia on the inhibition of the thermoregulatory defense mechanism is dose dependent and can result in perioperative hypothermia. The intraoperative vital signs record show that the lowest body temperature (35.5°C) occurs on during 30 minutes after operation started. During recovery from anesthesia, patient symptoms (including shivering thermogenesis, increased heart rates, and increased blood pressure) are heightened, and postoperative fever may be related to temperature loss via inhibition of temperature regulation and exposure of large intraoperative incisions [18, 20, 21]. The differential diagnosis of malignant hyperthermia (MH) does not have a clear physiological mechanism, although skeletal and muscle metabolic abnormalities and hypothyroidism are associated with anesthesia. Considering human genetic susceptibility along with how abnormal chromosomal genetics affect MH, anesthesia is a factor that can cause skeletal muscle stiffness, high metabolism and high fever; if not immediately treated, tissue damage or death can occur [22]. The diagnosis of MH is mainly based on indicators such as hyperpyrexia ($> 40^\circ\text{C}$), hyperlactic acid and increased PaCO_2 [23, 24]. In our patient, the arterial blood gas analysis results did not support the diagnosis of MH. In addition, glucocorticoid intervention may have been safe in our case [25] because the body temperature gradually returned to normal as time passed until the patient was discharged. Therefore, we reasoned that the symptom of immediate postoperative fever may be a self-limiting or self-regulating process, and there seemed to be no long-term adverse outcomes in our case with over three years of follow-up.

Postoperative tachycardia and hypertension are more frequent after general anesthesia [26]. In our case, the heart rate and blood pressure immediately increased at the beginning of anesthesia recovery; general anesthesia was a risk factor that impacted hemodynamic stability in patients with posterior lumbar surgery, with cytokines being the most important group of inflammatory mediators, as they regulate the alterations that are evident in hemodynamic, metabolic and immune responses [27]. Previous animal mechanistic research on sheep found that small doses of endotoxins evoked a dramatic biphasic response of opioid peptide secretion into the blood. The first phase began within minutes and coincided with a brief

hypertensive response to endotoxins well before the appearance of fever or hypotension. In addition, the late increases in cerebrospinal fluid iβ-EP after endotoxin administration suggest that physiological stimuli such as fever, which provoke an outpouring of iβ-EP into the periphery, may occur along with changes in central opioid peptide metabolism [28]. Based on this evidence, we consider general anesthesia to be a risk factor for fluctuations in hemodynamic stability.

In conclusion, immediate postoperative fever may be a self-limiting or self-regulating process in patients with scoliosis. The treatment intervention should be circumspect when patients experience such symptoms without clinical evidence because they may not have serious outcomes. Our case provides insufficient clinical evidence to determine whether this condition is due to transfusion reaction, or anesthesia inhibition.

Abbreviations

T: thoracic vertebra; PICOS: privacy and identity management for community services; CSF: cerebrospinal fluid; MH: malignant hyperthermia.

Declarations

-Ethics approval and consent to participate

The study protocol was approved by the ethics committee of the authors' institution, and good ethical research practice based on the Helsinki Declaration was followed (Application Petition Number YJLW2019001).

-Consent for publication

We confirm that we have duly considered the protection of intellectual property associated with this study and that there are no impediments to publication, including the images and clinical data of participants, with respect to intellectual property. We also confirm that we have followed the regulations of our institution concerning intellectual property and that we obtained written consent from the studied patient's parents (because the patient was a minor).

-Availability of data and materials

All information presented in this case report (including the images and clinical data) is stored in our institution's medical records archive. The authors did not allow the sharing of personal data that may identify the patient or reveal confidential patient data, such as the patient's name, ID number, and home address. The raw data for this case and related cases can be obtained from author Yiyue Zhong by e-mail.

-Competing interests

None of the authors have any potential conflicts of interest to report.

-Funding

Funding for clinical data collection, postoperative follow-up, analysis, and interpretation of data and in writing the manuscript in this study by the Science and Technology Fund Project of Zhanjiang (2017A01023, 2021A05073) and funding for language editing by the Clinical Research Fund of the Affiliated Hospital of Guangdong Medical University (LCYJ2019B008).

-Author contributions

XMC, MZM and YYZ developed the idea of the study, participated in its design and coordination and helped draft the manuscript. MZM and GXM contributed to the acquisition and interpretation of data. JSW provided a critical review and substantially revised the manuscript. All authors read and approved the final manuscript.

-Acknowledgments

The authors thank the following anesthetists and surgeons who kindly provided their assistance: Dr. GXM, Dr. JSW and Mr. LMZ, all from the Affiliated Hospital of Guangdong Medical University, China.

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Figures

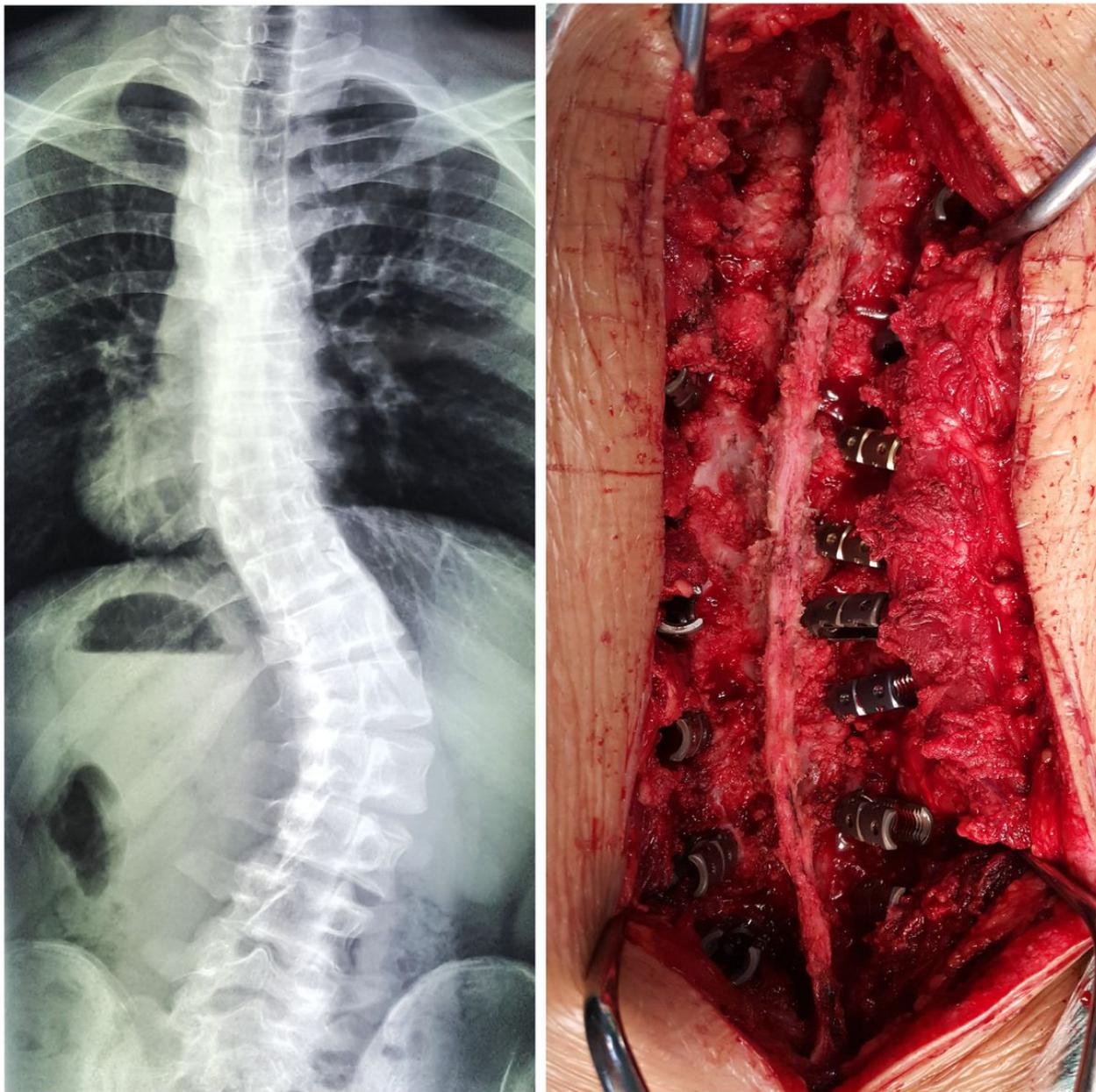


Figure 1

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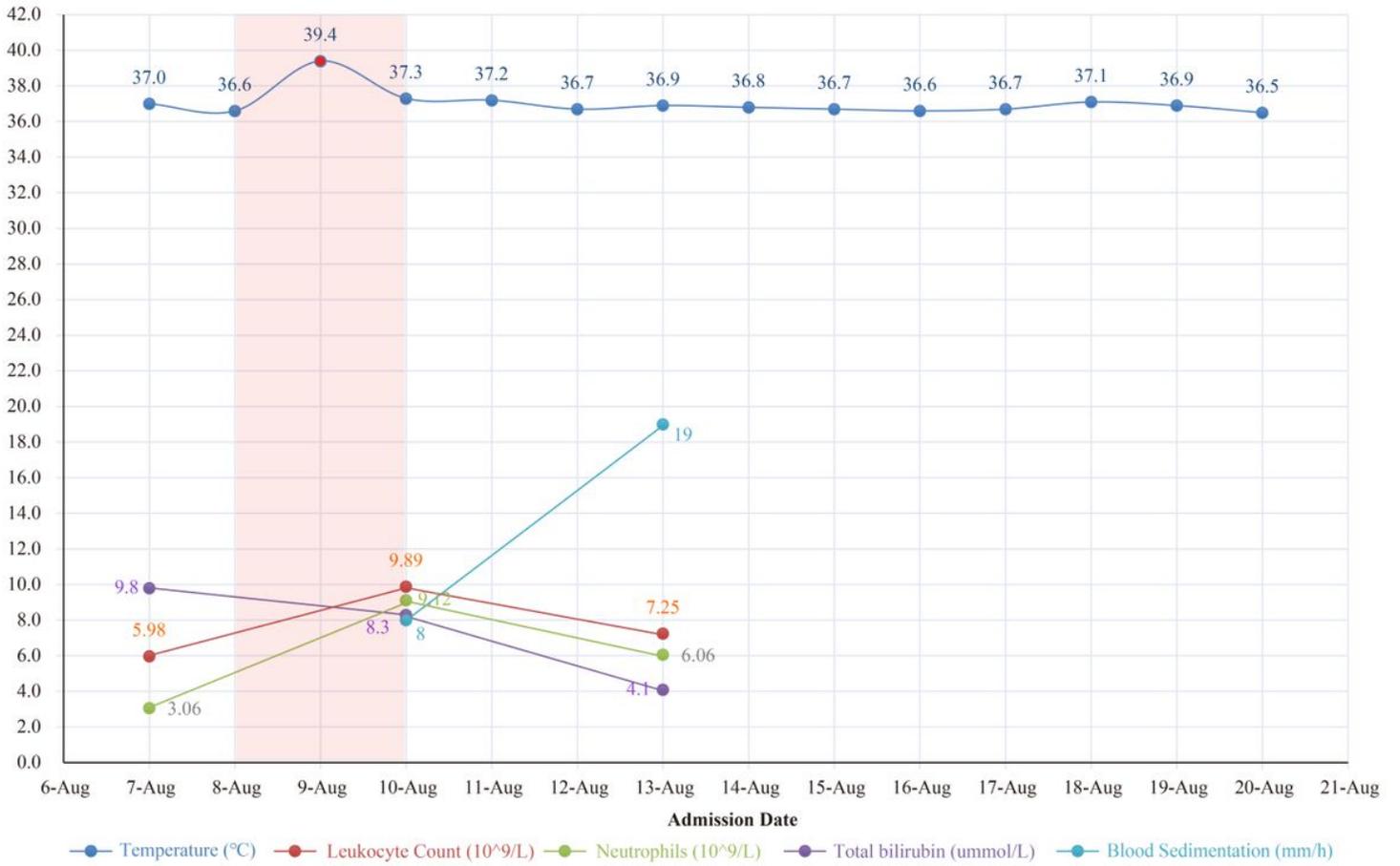


Figure 3

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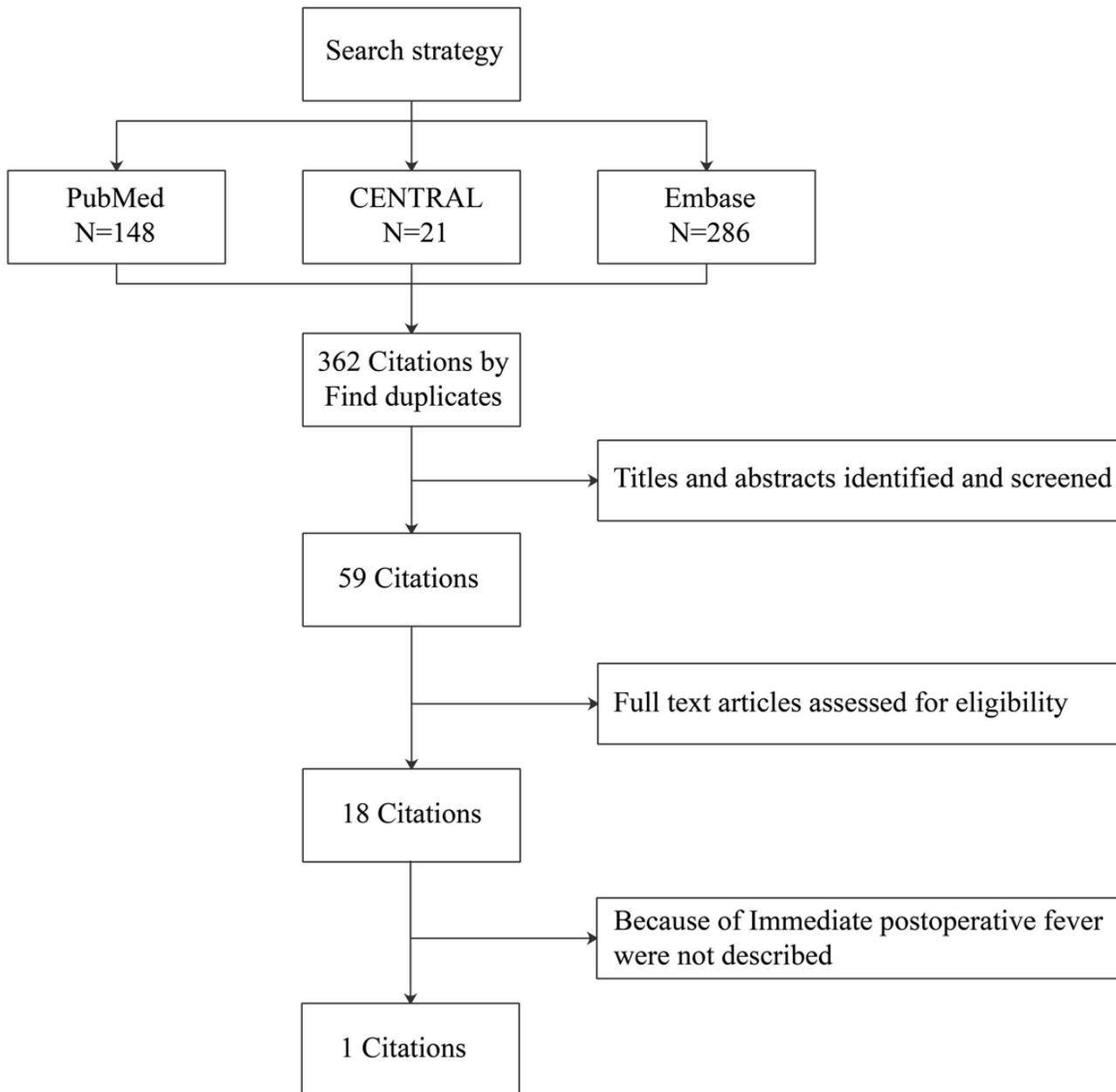


Figure 4

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