Intraoperative iatrogenic thermal burn in a dog associated with the use of an electric heating device: case management and surgical reconstruction

Arsura termică iatrogenă intraoperatorie la câine asociată cu utilizarea unui dispozitiv electric de încălzire: managementul cazului și reconstrucția chirurgicală

Tudor Căsălean, Cristian Zaha, Roxana Dascălu*, Romeo T. Cristina
Faculty of Veterinary Medicine Timișoara

tudorcasalean@gmail.com

Keywords: *dog, thermal burn, iatrogenic injury, wound management, reconstructive surgery*
Cuvinte cheie: *câine , arsură termică, leziune iatrogenică, tratarea plăgilor, chirurgie reconstructivă*

Abstract

Thermal burns in companion animals represent complex injuries associated with significant local tissue destruction and potentially severe systemic complications. Although relatively uncommon in small animal practice, iatrogenic burns associated with intraoperative warming devices remain clinically important due to their preventable nature and challenging therapeutic management. The present paper describes the clinical presentation, diagnostic evaluation, surgical management, and postoperative evolution of an intraoperative iatrogenic thermal burn in a 10-year-old mixed-breed dog following ovariohysterectomy. According to the anamnesis, an electric heating blanket designed for human use was applied during anesthesia for approximately 90 minutes in order to prevent hypothermia. Clinical lesions became evident within 24–72 hours postoperatively and progressed to extensive mixed-depth burns involving cervical, thoracic, and lumbar dorsal regions. Hematological and biochemical abnormalities included regenerative anemia, inflammatory leukogram, hepatic enzyme elevation, and early renal impairment. Initial conservative treatment was followed by delayed surgical debridement and reconstructive procedures using advancement techniques and tension-relieving sutures. Residual defects were managed with hydrocolloid and non-adherent dressings. Progressive healing and favorable tissue remodeling were observed during follow-up. The report highlights the importance of early recognition of thermal injuries, individualized wound management, adequate analgesia, fluid therapy, and prevention protocols in veterinary medicine.

Rezumat

Arsurile termice la animalele de companie reprezintă leziuni complexe asociate cu distrugerea semnificativă a țesuturilor locale și complicații sistemice potențial severe. Deși relativ rare în practica veterinară pentru animale mici, arsurile iatrogene intraoperatori asociate cu dispozitivele de încălzire rămân importante din punct de vedere clinic datorită posibilității de prevenție și a gestionării terapeutice dificile. Prezenta lucrare descrie prezentarea clinică, diagnosticul, managementul chirurgical și evoluția postoperatorie a unei arsuri termice iatrogene intraoperatorii la un câine de rasă mixtă în vârstă de 10 ani, după ovariohisterectomie. Conform anamnezei, o pătură electrică de încălzire destinată utilizării umane a fost aplicată în timpul anesteziei timp de aproximativ 90 de minute, pentru a preveni hipotermia. Leziunile clinice au devenit evidente în intervalul de 24–72 de ore postoperator și au progresat către arsuri extinse de adâncime mixtă, implicând regiunile dorsale cervicale, toracice și lombare. Anomaliile hematologice și biochimice au inclus anemie regenerativă, leucogramă inflamatorie, creșterea enzimelor hepatice și insuficiență renală precoce. Tratamentul conservator inițial a fost urmat de debridare chirurgicală întârziată și proceduri reconstructive folosind tehnici de avansare și suturi de eliberare a tensiunii. Defectele reziduale au fost tratate cu pansamente hidrocoloide și neaderente. În timpul urmăririi evoluției s-au observat vindecarea progresivă și remodelarea favorabilă a țesuturilor. Raportul de caz subliniază importanța recunoașterii timpurii a leziunilor termice, a gestionării individualizate a plăgilor, a analgeziei adecvate, a fluido-terapiei și a protocoalelor de prevenire în medicina veterinară.

1. Introduction

Burn injuries in small animals may present with a broad spectrum of clinical manifestations, ranging from superficial lesions that heal rapidly without intervention to extensive full-thickness burns associated with severe systemic complications and guarded prognosis [Johnston et al., 2018].

Severe burns should be considered complex pathological entities involving not only local tissue destruction but also significant cardiovascular, renal, gastrointestinal, and hematopoietic disturbances [Buote, 2024; Johnston et al., 2018].

In veterinary medicine, therapeutic recommendations regarding burn management are largely extrapolated from human medicine due to the relatively low incidence of severe burns in companion animals [Johnston et al., 2018].

Nevertheless, several veterinary reports have emphasized the increasing importance of individualized multimodal approaches combining fluid therapy, analgesia, debridement, reconstructive surgery, and advanced wound care techniques [Pavletic, 2018; Swaim et al., 2015].

Iatrogenic thermal injuries associated with warming devices used during anesthesia are uncommon but clinically significant complications.

Prolonged contact with improperly monitored heating sources may produce deep tissue injury, particularly in anesthetized patients incapable of behavioral thermoregulation or repositioning [Chung et al., 2012; Lee et al., 2020].

Similar cases involving thermal mattresses and forced-air warming systems have been described in both human and veterinary literature [Clark-Price et al., 2013; Gorczak Rochelle et al., 2021; Peteoacă et al., 2021].

The severity of thermal injury depends on the intensity and duration of heat exposure.

Burn lesions are commonly classified according to depth, ranging from superficial epidermal injuries to complete destruction of skin, subcutaneous tissue, fascia, muscle, and even bone [Johnston et al., 2018].

In addition to local tissue necrosis, major burns induce profound inflammatory responses associated with hypovolemia, increased vascular permeability, edema formation, oxidative stress, and immune dysregulation [Vaughn and Beckel, 2012; Vaughn et al., 2012].

Successful management of extensive burns requires accurate assessment of tissue viability and careful planning of debridement and reconstruction procedures.

In many veterinary patients, delayed debridement allows improved demarcation of necrotic tissue while minimizing unnecessary sacrifice of viable structures [Buote, 2024; Johnston et al., 2018].

Furthermore, the viscoelastic properties of canine skin provide important reconstructive advantages through tissue mobilization and tension-relieving techniques [Hosgood, 2012; Stanley, 2012].

The objective of the present report is to describe the diagnosis, treatment, surgical reconstruction, postoperative wound management, and clinical evolution of an extensive iatrogenic thermal burn in a canine patient while emphasizing the importance of prevention and perioperative safety.

2. Materials and methods

A 10-year-old mixed-breed female dog weighing 8.7 kg was referred to the Surgery Clinic of the Faculty of Veterinary Medicine, Timișoara, for evaluation of extensive dorsal skin lesions that developed after ovariohysterectomy performed for dystocia.

According to the anamnesis provided by the owner, the patient underwent surgery approximately 13 days before presentation.

During anesthesia, an electric heating blanket intended for human use was applied directly beneath the patient for approximately 90 minutes in order to prevent perioperative hypothermia.

Within 24 hours after surgery, the owner observed abnormal discoloration of the dorsal skin.

During the following 72 hours, progressive tissue rigidity, alopecia, reduced local temperature, and dark discoloration became evident (figure 1).

The lesions gradually evolved toward extensive necrosis with formation of thick adherent eschars.

Figure 1. Early clinical appearance of the dorsal thermal lesion at 48h post thermal burn

At presentation (13 days post incident) the patient exhibited apathy, reduced appetite, intermittent diarrhea, mild dehydration, and extensive dorsal lesions involving the cervical, thoracic, and lumbar regions.

Clinical examination revealed dry, thickened, alopecic skin with poor elasticity and areas of firm necrotic tissue lacking clear demarcation from viable tissue.

Pain response varied between regions, suggesting mixed-depth injury (figure 2).

Complete hematological and biochemical evaluation was performed in order to assess the systemic impact of the burn and to identify possible early complications.

Hematological analysis showed regenerative anemia characterized by:

- decreased erythrocyte count,
- hemoglobin concentration, and hematocrit,
- together with increased reticulocyte count.

Neutrophilia and monocytosis compatible with severe inflammatory response were also identified.

Biochemical evaluation revealed elevated alanine aminotransferase (ALT), alkaline phosphatase (ALP), serum urea, and creatinine concentrations suggestive of early renal impairment.

Figure 2. Clinical appearance at presentation, 13 days post thermal burn

Based on clinical examination and tissue appearance, the lesions were classified as mixed thermal burns including deep partial-thickness and full-thickness components [Johnston et al., 2018].

The absence of vesicle formation was considered compatible with species-specific anatomical characteristics of canine skin, particularly the reduced development of superficial dermal capillary networks compared with humans [Buote, 2024; Langley-Hobbs et al., 2014; Pavletic, 2018].

Initial treatment focused on stabilization of the patient, prevention of systemic deterioration, and local wound management.

Fluid therapy was initiated using isotonic crystalloids in order to restore peripheral perfusion and maintain adequate hydration.

Restoration of normo-volemia remains one of the principal therapeutic objectives in severe burn management [Buote, 2024; Johnston et al., 2018].

Broad-spectrum antimicrobial therapy was instituted, and multimodal analgesia protocols were applied according to the patient's clinical status.

Conservative topical management initially aimed to support tissue demarcation and gradual separation of necrotic structures.

However, only minimal spontaneous eschar separation was observed, and the remaining necrotic tissue remained firmly attached to the underlying tissues.

Because conservative treatment failed to provide adequate wound bed preparation, surgical intervention was selected as the main therapeutic step.

The decision was based on the persistence of extensive devitalized tissue, the risk of infection, and the need to establish a viable wound bed for reconstruction and secondary healing.

The main surgical objectives were:

- complete removal of nonviable tissue,
- preservation of viable vascularized structures,
- reduction of bacterial contamination, and
- preparation of the wound bed for reconstruction and
- controlled secondary healing.

Approximately 25 days after the initial thermal injury, the patient underwent general anesthesia and extensive escarectomy (figure 3).

Delayed debridement was intentionally selected in order to allow clearer demarcation between viable and nonviable tissues, thereby minimizing unnecessary excision of healthy skin.

The necrotic eschar was progressively excised using sharp dissection until punctate bleeding and viable tissue margins became evident.

Particular care was taken to preserve subdermal vascular supply because extensive thermal injuries may compromise local perfusion and increase the risk of secondary necrosis.

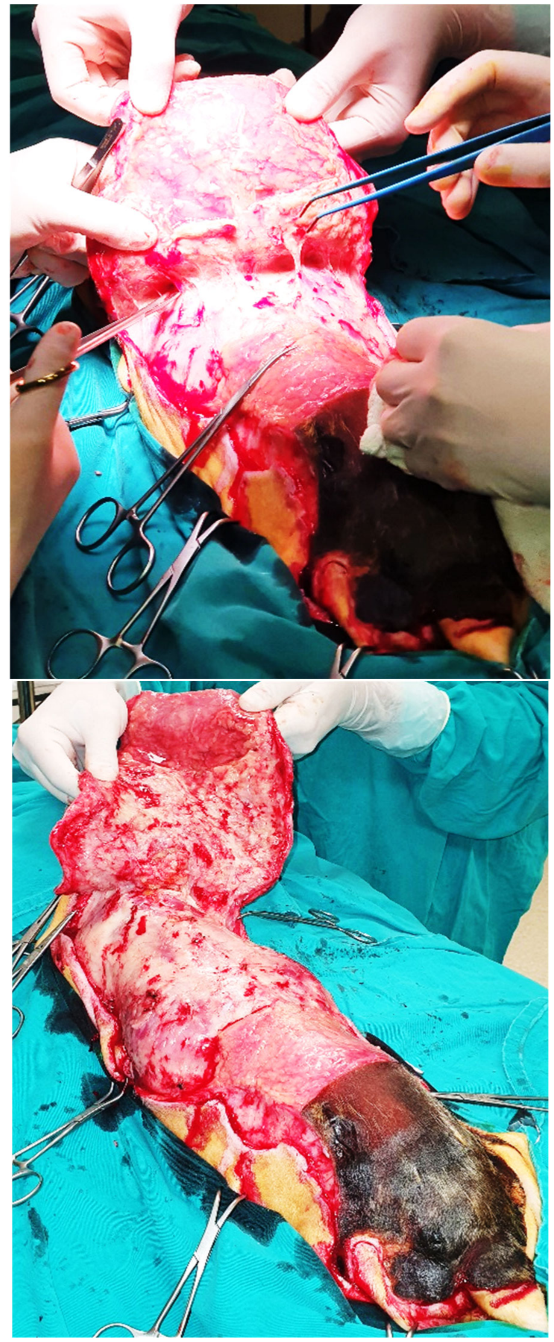
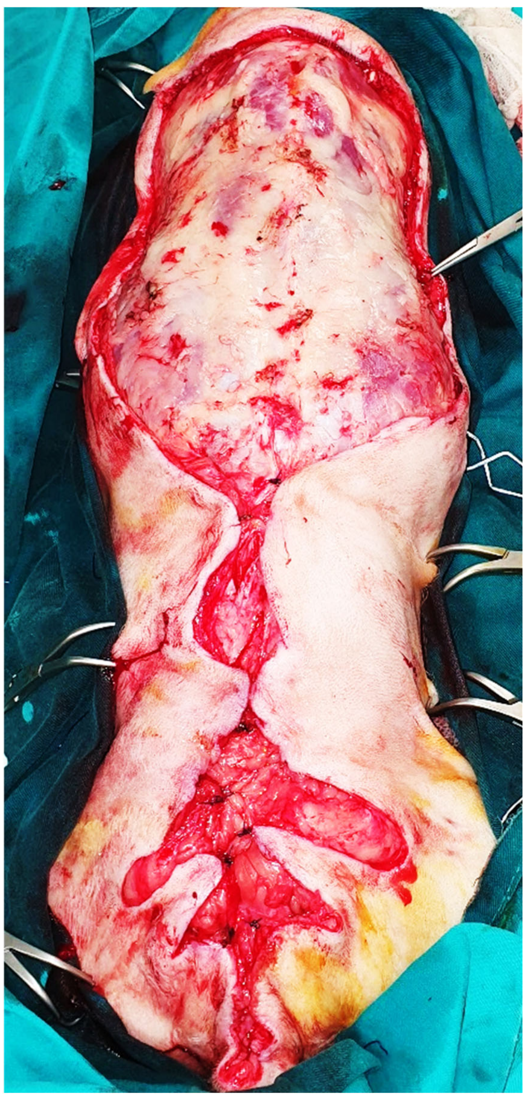


Figure 3. Dorsal wound during surgical debridement, showing extensive necrotic tissue and eschar.

The final defect involved large portions of the cervical and thoracolumbar dorsal regions and could not be managed through direct primary closure without excessive tension (figure 4).

Figure 4. Complete surgical debridement achieving a wound bed free of nonviable tissue, but resulting in a very large cutaneous defect.

Reconstructive planning focused on achieving maximal wound coverage while maintaining tissue perfusion and minimizing tension across the suture lines.



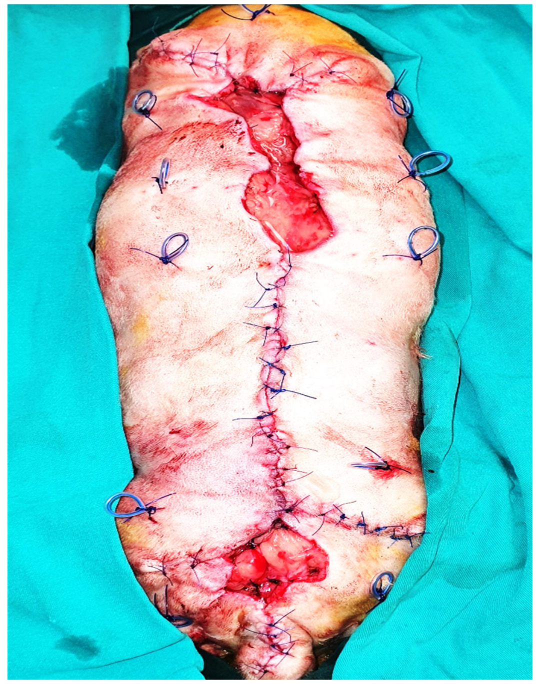


Figure 5. Partial closure of the cutaneous defect by bilateral mobilization and advancement of the skin margins.

Bilateral skin mobilization and advancement techniques were performed using the inherent elasticity and mobility of canine dorsal skin.

Extensive undermining was carried out carefully in the subcutaneous plane to facilitate advancement of adjacent tissues.

Tension-relieving sutures were strategically positioned in order to redistribute mechanical stress, reduce ischemic compromise at wound margins, decrease the likelihood of wound dehiscence, and improve postoperative comfort. The reconstructive approach allowed partial primary closure of the defect while preserving acceptable vascularization of the mobilized flaps (figure 5).

Residual uncovered regions were intentionally managed as open wounds because excessive closure tension was considered likely to compromise tissue viability [Hosgood, 2012; Stanley, 2012].

Postoperative wound management represented a critical component of therapy and required continuous reassessment of tissue viability, exudate production, local perfusion, and progression of granulation tissue. Residual wound areas were managed using hydrocolloid dressings combined with non-adherent polyurethane contact layers.

These materials were selected in order to maintain a moist wound environment while minimizing trauma during bandage changes (figure 6.)

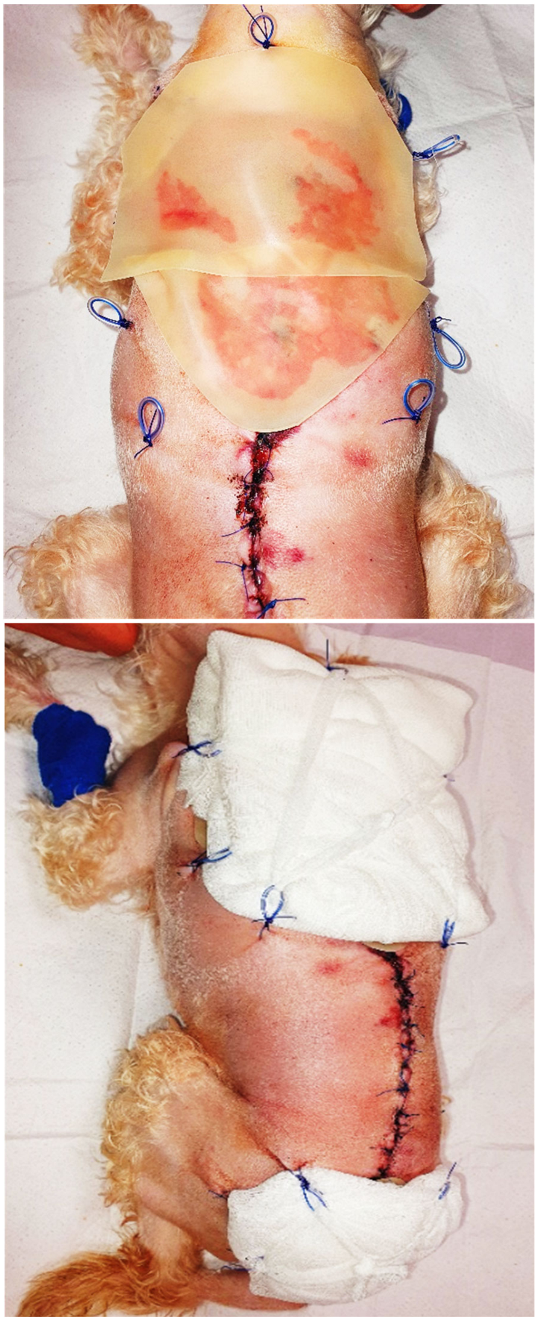


Figure 6. Wound protection: application of a hydrocolloid dressing Medisorb H, Malopat, followed by a thick sterile gauze pad, secured in place by passing a narrow strip of gauze diagonally through the loops of the silicone tube positioned circumferentially around the wound.

Bandages were replaced regularly under aseptic conditions.

During each dressing change, the wound was evaluated for granulation tissue formation, epithelial migration, exudate quantity and appearance, evidence of secondary infection, tissue perfusion, and marginal viability.

Topical cleansing was performed carefully to avoid disruption of immature granulation tissue.

The hydrocolloid dressing system contributed to maintenance of local humidity and reduction of tissue desiccation, while the non-adherent contact layer limited tissue trauma during dressing removal [Bolton et al., 2000; Nuutila and Eriksson, 2021].

Analgesic management included multimodal protocols adapted according to patient comfort and clinical progression.

Pain control was considered essential because repeated bandage changes and wound manipulation may produce significant stress and discomfort in burn patients [Fossum and Duprey, 2019; Johnston et al., 2018].

Systemic antimicrobial therapy and fluid therapy were continued during the immediate postoperative period.

Close monitoring was performed in order to detect potential complications including dehiscence, flap ischemia, excessive exudation, infection, or progression of necrosis.

3. Results

Progressive granulation tissue formation was observed during postoperative monitoring.

The wound surface gradually decreased through a combination of tissue contraction, epithelialization, and continued maturation of granulation tissue (figure 7).

No major postoperative complications such as complete dehiscence or septic deterioration were observed. Bandage tolerance was satisfactory, and exudate production progressively diminished during follow-up evaluations. Subsequent examinations demonstrated improved tissue vascularization, reduction of inflammatory exudate, gradual epithelial migration from wound margins, and acceptable cosmetic and functional outcome.

Figure 7. Different stages of the wound; up: late inflammation stage of the wound with debut of granulation tissue - 5 days p.o.; down: contraction and epithelialization stages – 15 days p.o.

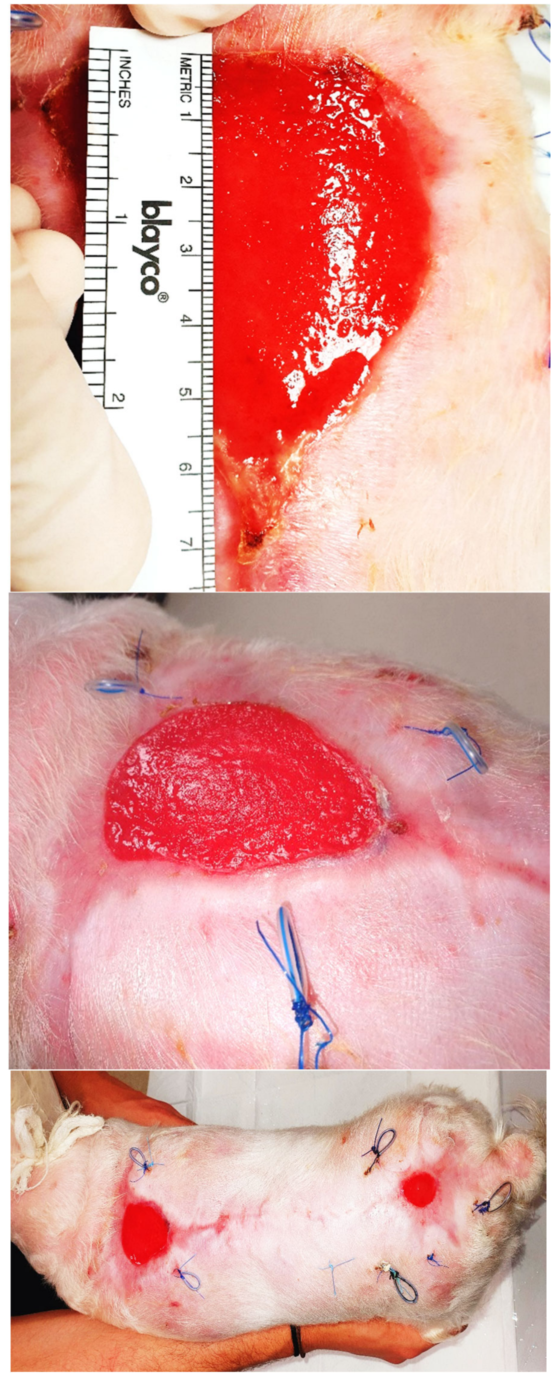


Figure 8. Different wound stages; up: **day 28** p.o; middle: **day 38** p.o; down: **day 47** p.o.

Long-term follow-up revealed stable scar tissue formation without recurrence of necrosis (figure 8).

5. Discussion

Burn injuries represent some of the most challenging wounds encountered in veterinary surgery because they involve complex interactions between local tissue destruction and systemic inflammatory responses [Vaughn and Beckel, 2012; Vaughn et al., 2012].

The present case highlights the severe consequences associated with improper use of intraoperative heating devices.

Thermal support systems are frequently employed during anesthesia because hypothermia is a common perioperative complication in small animal patients [Clark-Price et al., 2013].

However, prolonged direct contact with uncontrolled heat sources may result in severe tissue injury, especially in anesthetized animals incapable of repositioning themselves in response to excessive temperature.

Comparable veterinary reports involving thermal mattresses and forced-air warming devices have described similar patterns of tissue necrosis and delayed clinical recognition [Gorczak Rochelle et al., 2021; Lee et al., 2020; Peteoacă et al., 2021].

In the current patient, lesions became clinically evident only after surgery, emphasizing the delayed progression characteristic of thermal burns.

Burn severity frequently evolves during the first 48–72 hours due to progressive vascular compromise and inflammatory cascade activation [Johnston et al., 2018].

The observed hematological and biochemical abnormalities reflected systemic inflammatory involvement secondary to extensive burns.

Anemia associated with thermal injury may result from hemolysis, erythrocyte destruction, inflammatory suppression of erythropoiesis, and tissue fluid shifts [Johnston et al., 2018].

Likewise, renal dysfunction may occur secondary to hypovolemia, inflammatory mediators, reduced perfusion, and oxidative stress.

Fluid therapy remains one of the cornerstones of burn management because restoration of circulating volume and tissue perfusion directly influences survival and wound healing [Buote, 2024; Johnston et al., 2018]. In the present case, isotonic crystalloids were used for hemodynamic stabilization and renal support.

The timing of surgical debridement in burn patients remains controversial.

Early debridement may reduce bacterial contamination and inflammatory mediator release; however, delayed intervention can facilitate clearer demarcation of necrotic tissue and preservation of viable structures [Buote, 2024].

In this patient, delayed escarectomy permitted more accurate assessment of tissue viability and contributed to satisfactory reconstructive planning. Canine skin biomechanics played a critical role during reconstruction.

The viscoelastic and mobile characteristics of canine skin allow significant advancement and redistribution of tension compared with other species [Singh, 2017].

Nevertheless, excessive tension may induce ischemia and secondary dehiscence, making tension-relieving techniques essential in extensive closures [Hosgood, 2012; Stanley, 2012].

Moist wound healing strategies were also important in the present case.

Multiple studies have demonstrated that hydrocolloid and semi-occlusive dressings improve epithelial migration and support granulation tissue development [Morgan et al., 1994, Ramsey et al., 1995].

Similar beneficial effects have been reported in canine burn management using hydrocolloid materials [Gomide et al., 2020].

Pain management constitutes another essential component of burn treatment.

Burn-associated pain includes background pain, procedural pain, and breakthrough pain, all of which may negatively influence recovery and stress response [Johnston et al., 2018].

Adequate multimodal analgesia likely contributed substantially to patient comfort and clinical progression.

Finally, this case emphasizes the importance of prevention.

Appropriate intraoperative thermal support should involve veterinary-approved warming systems, continuous temperature monitoring, placement of protective insulating layers, periodic patient repositioning, and avoidance of prolonged direct contact between the patient and heating devices.

6. Conclusions

The present report describes the successful management of an extensive intraoperative iatrogenic thermal burn in a canine patient.

The case demonstrates that thermal support devices may cause severe injuries if improperly monitored.

Burn lesions should be considered systemic conditions rather than exclusively local injuries and early stabilization and adequate fluid therapy are essential.

Furthermore, delayed surgical debridement may facilitate accurate tissue viability assessment and reconstructive surgery combined with tension-relieving techniques can provide satisfactory closure in extensive defects.

Hydrocolloid and non-adherent dressings contribute positively to wound healing and prevention through perioperative monitoring protocols remains critically important.

Successful outcome in the present case was achieved through individualized multimodal management combining systemic stabilization, surgical debridement, reconstructive techniques, analgesia, and advanced wound care.

References

1. **Bohling, M.W. (2012).** Arsuri. În: Tobias K.M. și Johnston S.A., ed. Chirurgie veterinară: animale mici. Saunders Elsevier, St Louis, 1291-1301.
2. **Bolton, L.L., Monte, K., Pirone, L.A. (2000).** Umiditate și vindecare: dincolo de jargon. Ostomy Wound Management, 46(Suppl 1A), 51S–62S.
3. **Buote Nicole, J. (2024).** Tehnici în gestionarea rănilor la animale mici. John Wiley & Sons, Hoboken, New Jersey, 127-154.
4. **Chung, K., Lee, S., Oh, S.C. et al. (2012).** Leziuni termice asociate cu un dispozitiv de încălzire cu aer forțat. *Korean J Anesthesiol.*, 62, 391-392.
5. **Clark-Price, S.C., Dossin, O., Jones, K.R. et al. (2013).** Compararea a trei metode diferite de prevenire a pierderii de căldură la câini sănătoși supuși unei anestezii generale de 90 de minute. *Vet Anaest Analg.*, 40(3), 280-284.
6. **Fossum, T.W., Duprey, L.P. (2019).** Chirurgia animalelor mici (ediția a 5-a). Elsevier, 141-157.
7. **Gomide Paula, R.S., Kobori, L.N., Tetzner, B.C. et al. (2020).** Utilizarea hidrocoloidului în tratamentul leziunilor termice la un câine. *Acta Scientiae Veterinariae,* 48 (Suppl 1), 585.
8. Gorczak Rochelle, M.A.V., Michels, I.C. et al. (2021). Arsuri cutanate cauzate de saltea termică – O abordare terapeutică. *Acta Sci Vet.*, 49(Suppl 1), 594.
9. **Hosgood, G. (2012).** Tehnici de reducere a tensiunii. În: Tobias K.M. și Johnston S.A., Eds. Chirurgie veterinară: animale mici. Saunders Elsevier, St Louis, 3669-3691.
10. **Johnston, S.A., Tobias, K.M., Peck, J.N. et al. (2018).** Chirurgie veterinară: animale mici. Vol. 2. Elsevier, 3804-3890.
11. **Langley-Hobbs, S.J., Demetriou, J., Ladlow, J.F. (2014).** Chirurgia țesuturilor moi și chirurgia generală la pisici. Saunders Elsevier, 177-183.
12. **Lee, S., Lee, A., Lee, M. et al. (2020).** Leziune prin arsură termică cauzată de un dispozitiv de încălzire cu aer forțat la un câine anesteziat cu hipoperfuzie periferică. *J. Vet Clin.*, 37(6), 331-335.
13. **Morgan, P.W., Binnington, A.G., Miller, C.W. et al. (1994).** Efectul pansamentelor ocluzive și semi-ocluzive asupra vindecării rănilor cutanate acute de grosime completă la membrele anterioare ale câinilor. *Chir. Vet.,* 23(6), 494-502.
14. **Nuutila, K., Eriksson, E. (2021).** Vindecarea umedă a rănilor cu pansamente disponibile în mod obișnuit. *Adv. Wound Care*, 10, 685-698.
15. **Pavletic, M.M. (2018).** Atlasul tratamentului rănilor și chirurgiei

reconstructive la animale mici. Wiley Blackwell, 1-115.

16. **Peteoacă Alexandra, Ionașcu Iuliana, Tănase, A. (2021).** Managementul leziunilor termice iatrogene la un câine geriatric – un raport de caz. *Lucrări științifice. Seria C. Medicină veterinară, LXVII (2).*
17. **Ramsey, D.T., Pope, E.R., Wagner-Mann, C. et al. (1995**). Efectele a trei materiale de pansament ocluziv asupra vindecării rănilor cutanate de grosime completă la câini. *AJVR,* 56(7), 941-949.
18. **Singh, B. (2017).** Manualul de anatomie veterinară al lui Dyce, Sack și Wensing (ediția a 5-a). Saunders, 580-610.
19. **Stanley, B.J. (2012).** Tehnici de eliberare a tensiunii. În: Tobias K.M. și Johnston S.A., ed. Chirurgie veterinară: animale mici. Saunders Elsevier, St Louis, 3697-3716.
20. **Swaim, S.F., Welch, J.A., Gillette, R.L. (2015).** Managementul leziunilor membrelor distale la animalele mici. Teton NewMedia, 2-209.
21. **Vaughn, L., Beckel, N. (2012).** Arsuri grave, șoc termic și leziuni cauzate de inhalarea fumului la animale mici. Partea 1: Clasificarea arsurilor și fiziopatologia. *J Vet. Emerg. Critical Care,* 22(2), 179-186.