

超氧淨水機

Ozone Helps Generator

滅菌 / 護理 / 保養 / 修復

獸醫學中的臭氧療法 臨床適應症與技術

Ozone therapy in veterinary medicine

Clinical indications and techniques

INTRODUCTION

Therapeutic ozone is generated when pure medicinal oxygen is converted through ozone generators, producing a mixture of the two gases, oxygen-ozone (O₂-O₃), with its ozone concentration ranging from 0.05 to 5% (1 to 107 µg/mL) and consequently oxygen concentration ranging from 99.95% to 95% (OLIVEIRA JUNIOR; LAGES, 2012; SCHWARTZ et al., 2020).

當純藥用氧氣通過臭氧發生器轉化時，會產生治療性臭氧，產生兩種氣體的混合物，即氧-臭氧（O₂-O₃），其臭氧濃度範圍為 0.05 至 5%（1 至 107 µg/mL），因此氧氣濃度範圍為 99.95% 至 95%。

The oxidative effect of ozone promotes bactericidal, fungicidal, and virucidal properties. It is used in the treatment of circulatory arterial diseases, external ulcers, skin lesions, immunodeficiency, hepatitis, supportive therapy in cancer patients, inflammations, and dental treatments.

臭氧的氧化作用可促進殺菌、殺蟲和殺病毒特性。它用於治療循環動脈疾病、外部潰瘍、皮膚病變、免疫性無缺陷症、肝炎、癌症患者的支持療法、炎症和牙科治療。

Because of the ozone virucidal effect and indirect immunity stimulation, several studies for the treatment of herpes and human immunodeficiency are being done (PENIDO; LIMA; FERREIRA, 2010).

由於臭氧殺病毒作用和間接免疫刺激，正在進行幾項治療疱疹和人類免疫缺陷的研究。

ABSTRACT: Ozone therapy application and research have increased recently. The mixture of oxygen-ozone (O₂-O₃) has been used as a therapeutic agent for the treatment of several diseases with beneficial effects. This brief literature review has

the objective of disclosing the mechanisms of action and main clinical indications and possibilities of ozone therapy for different conditions.

摘要：臭氧療法的應用和研究最近有所增加。氧臭氧（O₂-O₃）的混合物已被用作治療多種疾病的治療劑，具有有益的效果。本簡短的文獻綜述旨在揭示臭氧治療針對不同病症的作用機制和主要臨床適應症和可能性。

The local and systemic approaches and techniques described for human treatment can be easily transposed for use in animals, such as rectal insufflation; bag therapy; ozonated oil; intradiscal and paravertebral applications; in acupuncture points; minor autohemotherapy, and major autohemotherapy.

描述的用於人類治療的局部和全身方法和技術可以很容易地轉作用於動物，例如直腸注入；袋療法；臭氧油；椎間盤內和椎旁應用；在穴位；次要自血療法和主要自血療法。

The possibilities of clinical indications and dosages were also described, including immunological and infectious diseases. Although it is a minimally invasive and relatively safe approach, more clinical studies are necessary to standardize techniques, doses, and clinical indications.

還描述了臨床適應症和劑量的可能性，包括免疫學和傳染病。儘管這是一種微創且相對安全的方法，但需要更多的臨床研究來標準化技術、劑量和臨床適應症。

KEYWORDS: pain; antioxidant; disk disease; chemical acupuncture; autohemotherapy; COVID-19.

關鍵詞：疼痛；抗氧化劑；椎間盤疾病；化學針灸；自體血液療法；COVID-19。

Ozone therapy in veterinary medicine: clinical indications and techniques a veterinary and a dentistry. The purpose of this brief literature review is to disclose the mechanisms of action, main indications, and possibilities for the use of ozone therapy under different conditions in veterinary medicine. Also, to describe the several types of applications in small animals.

獸醫學中的臭氧療法：臨床適應症和技術獸醫和牙科。本簡短文獻綜述的目的是揭示在獸醫學不同條件下使用臭氧療法的作用機制、主要適應症和可能性。此外，描述小動物的幾種應用類型。

The ozone (O₃) is a potent oxidizer and it has a more selective activity over organic compounds (PENIDO; LIMA; FERREIRA, 2010). 臭氧（O₃）是一種有效的氧化劑，它比有機化合物具有更強的選擇性活性（PENIDO;利馬;FERREIRA，2010年）。

The likely mechanisms of action of this mixture of oxygen-ozone (O₂-O₃) are due to the biochemical properties of O₃ producing analgesic, anti-inflammatory, antioxidant and immunomodulatory effects.

這種氧-臭氧（O₂-O₃）混合物的可能作用機制是由於 O₃ 的生化特性產生鎮痛、抗炎、抗氧化和免疫調節作用。

The events that promote these effects can be resumed by: activation of cellular metabolism, reduction of proinflammatory prostaglandins synthesis or release of algogenic compounds, increase of release of immunosuppressive cytokines, reduction of oxidative stress through the induction of the synthesis of antioxidant enzymes (superoxide dismutase, glutathione peroxidase, and catalase), increase of O₂ supply at tissues and stimulation of angiogenesis (BOCCI, 2006; LATINI et al., 2019; PENIDO; LIMA; FERREIRA, 2010).

促進這些影響的事件可以透過以下方式恢復：活化細胞代謝，減少前列腺素的合成或釋放致痛化合物，增加免疫抑制細胞因子的釋放，透過誘導抗氧化酶（超氧化物歧化酶、穀胱甘肽過氧化物酶和過氧化氫酶）的合成來減少氧化應激，增加組織的 O₂ 供應並刺激血管生成。

The therapeutic efficacy of ozone therapy is due to the controlled and moderate oxidative stress produced by O₃ reactions with various biological components.

臭氧療法的治療效果是由於 O₃ 反應與各種生物成分產生的受控和適度氧化應激。

The calculated and transient oxidative stress induced by O₃ generates several second messengers in several intracellular signals (BOCCI, 2006; LATINI et al., 2019). This property of ozone is known as paradoxical action because it plays a role as an oxidizing molecule and can increase the antioxidant properties of regions affected by the disease (SCIORSI et al., 2020).

由 O₃ 誘導的計算和暫態氧化應激在幾種細胞內信號中產生幾個第二信使。臭氧的這種特性被稱為矛盾作用，因為它起著氧化分子的作用，可以增加受疾病影響區域的抗氧化特性。

INSTRUMENTAL AND OZONE APPLICATION TECHNIQUES 儀器和臭氧應用技術

As it is a highly unstable molecule, the proximity of the ozone generator device during the application is necessary, so that its collection is performed moments before the treatment, allowing the reliability of the correct dose and concentrations.

由於它是一種高度不穩定的分子，因此在應用過程中臭氧發生器裝置的接近是必要的，以便在處理前片刻進行其收集，從而確保正確劑量和濃度的可靠性。

O3 = ozone 臭氧 ; ROS = Reactive Oxygen Species 活性氧 ; LOP= Lipid Oxidation Product 脂質氧化產物; ATP= Adenosine Triphosphate 三磷酸腺苷.

For the oxygen molecule to break down, a large amount of energy is required which may be due to electrical discharges, chemical electrolysis, and ultraviolet light radiation.

氧分子要分解，需要大量的能量，這可能是由於放電、化學電解和紫外線輻射造成的。

It can still be produced by thermal, radiochemical, and electrochemical method.

The triatomic form is unstable and its stability is temperature-dependent.

它仍然可以通過熱、放射化學和電化學方法生產。**三原子形式不穩定，其穩定性與溫度有關。**

Thus, at 20°C the average life of the O3 gas is 40 minutes and at 30°C, the average life is 25 minutes (BOCCI, 2005). Thus, it cannot be stored and its use must be carried out right after its collection.

因此，在 **20°C** 時，O3 氣體的平均壽命為 **40 分鐘**，在 **30°C** 時，平均壽命為 **25 分鐘**（BOCCI，2005 年）。因此，**它不能被存儲，必須在收集後立即使用。**

Ozone Therapy techniques several techniques of applying medical ozone are described. Both local and systemic via are described. The different ways of ozone therapy can be used alone or together to obtain a synergistic effect.

臭氧療法技術 描述了幾種應用醫用臭氧的技術。描述了局部和全身系統。臭氧療法的不同方式可以單獨使用，也可以一起使用以獲得協同效應。

The general rule is each five ozone sessions, an increase of ozone dose as a cycle, and this cycle can vary between 15 or 20 sessions. Clinical improvement is observed between five to ten applications, due to activation of the self-defense antioxidant mechanism.

一般規則是每 5 次臭氧治療，臭氧劑量作為一個週期增加，這個週期可以在 15 或 20 次之間變化。由於啟動了自我防禦抗氧化機制，在 5 到 10 次應用之間觀察到臨床改善。

All materials must be ozone resistant, like glass, silicon probes/tubes/syringes. It is described as a therapeutic window of secure ozone concentrations between 10 to 60 μ g/mL, without toxicity or side effects (KAWAHARA et al., 2019).

所有材料都必須耐臭氧，如玻璃、矽探針。它被描述為**安全臭氧濃度在 10 至 60 μ g/mL 之間且無毒性或副作用的治療視窗。**

Local techniques 局部技術

A- Rectal Insufflation 直腸注入法

The rectal application of drugs is an initially local modality, but it can be used for the administration of systemic drugs. Rectal ozone insufflation has low toxicity and corresponds to a popular via **in veterinary medicine** due to its easy application and because it is an alternative to the use of major autohemotherapy (SANCHEZ; RE, 2012; TEIXEIRA et al.,2013). It consists of the ozone rectal application assisted with an urethral probe.

藥物的直腸應用最初是一種局部方式，但它可用於全身性藥物的給藥。直腸臭氧注入具有低毒性，由於其易於應用並且因為它是使用主要自血療法的替代方法，因此對應於**獸醫學**中的流行。它包括臭氧直腸應用，並輔以尿道探針(導尿管)。

The gas quickly dissolves within the content of the intestinal lumen, reacts with mucoproteins and other released substances with antioxidant activity, and produces reactive oxygen species (ROS: Reactive Oxygen Species) and lipid peroxidation products (LOPs Lipid Oxidation Product:) that penetrate the mucosa. Hey are absorbed via blood and lymphatic circulation (SCHWARTZ; SÁNCHEZ; SABAH, 2015).

該氣體迅速溶解在腸腔內容物中，與粘蛋白和其他具有抗氧化活性的釋放物質反應，併產生滲透粘膜的活性氧（**ROS**）和脂質過氧化產物（**LOP**）。通過血液和淋巴迴圈吸收。

B - Ozone Bagging臭氧袋

The ozone bagging is widely used in **veterinary medicine** for wounds and purulent skin infections, ulcers, and skin diseases.

臭氧袋廣泛用於**獸醫學**，用於治療傷口和 膿性皮膚感染、潰瘍和皮膚病。

The O₂-O₃ mixture is pumped into an ozone-resistant bag, such as silicone or polypropylene, that is then placed around the area to be treated but previously moistened with distilled water to facilitate the penetration through the lesion site. 將 O₂-O₃ 混合物灌入耐臭氧袋（例如矽膠或聚丙烯）中，然後將其放置在要治療的區域周圍，但事先用蒸餾水潤濕要治療的區域，以促進滲透病變部位。

Ozone reacts with minerals, so the bi-distilled/distilled water or water purified by the reverse osmosis process has lesser reagents to produce not desirable products. 臭氧與礦物質發生反應，因此雙蒸/蒸餾水或通過反滲透工藝淨化的水具有較少的反應物，產

生不需要的產品。

The O₂ -O₃ mixture is inflated by a vacuum system until the bag is full. The wound to be treated will be surrounded by the gas, and it must be acting for 20 to 30 minutes. (SCHWARTZ; SÁNCHEZ; SABAH, 2015). O₂ -O₃ 混合物通過真空系統充氣，直到袋子裝滿。待治療的傷口將被臭氧氣體包圍，並且必須作用 20 到 30 分鐘。

C - Ozonated oil 臭氧油

The oil is the result of the interaction between vegetable oil and ozone and produces a mixture of chemical compounds such as ozonides and peroxides with a germicidal effect. Ozonated oil can be used topically and orally. (LINCHETA et al., 1998).

該油是植物油和臭氧相互作用的結果，可產生具有殺菌作用的化合物（如臭氧和過氧化物）的混合物。臭氧油可以局部和口服使用。

This kind of ozone application was very safe and has demonstrated activity for use in the prevention and treatment of chronic local infections, topical antimicrobial agents, in treatment of wounds and foot ulcers in patients with diabetes, anaerobic infections, herpetic infections (HSV I and II), trophic ulcers and burns, cellulitis, abscesses, anal fissures, decubitus ulcers (bed sores), fistulae, fungal diseases, furunculosis, gingivitis, and vulvovaginitis (BOCCI, 2005; UGAZIO et al., 2020).

這種臭氧油應用非常安全，並已顯示出用於預防和治療慢性局部感染、局部抗菌劑、治療糖尿病患者的傷口和足部潰瘍、厭氧菌感染、疱疹感染（HSV I 和 II）、營養性潰瘍和燒傷、蜂窩組織炎、膿腫、肛裂、褥瘡（褥瘡）、癰管、真菌病、癬病、牙齦炎和外陰陰道炎。

Ozonated oil is produced by incorporating the O₂-O₃ mixture into triglycerides where gaseous ozone chemically reacts with unsaturated substrates leading to therapeutically active.

臭氧油是透過將 O₂-O₃ 混合物加入甘油三酸酯中而產生的，其中氣態臭氧與不飽和底物發生化學反應，從而產生具有治療活性的。

Ozone therapy **in veterinary medicine**: clinical indications and techniques ozonated derivatives (ozonide). The ozonide compositions deliver active O₂ and/or other useful species deep within the lesion without causing primary skin irritation.

獸醫學中的臭氧療法：臨床適應症和技術：臭氧化衍生物（臭氧化物）。臭氧化物組合物可將活性 O₂ 和/或其他有益物質輸送至病灶深層，而不會引起原發性皮膚刺激。

They can eliminate the pathogens and then, by releasing oxygen (O₂), activate the proliferation of fibroblasts, hence the building of an intercellular matrix with the consequent proliferation of keratin blasts and successive healing.

它們可以消除病原體，然後通過釋放氧氣（O₂）啟動成纖維細胞的增殖，從而構建細胞間基質，從而導致角蛋白原始細胞的增殖和連續癒合。最常用的油是橄欖油、芝麻油和葵花籽油。

Successful treatment with the topic of ozonated oil was described for skin lesions in a **dog** (SILVA JÚNIOR et al.,2019). Oral treatment can be also administered for H.pylori infection in human patients (SOTO; ROMO-VASQUEZ; WEBER-CHULIÁ, 2018).

描述了臭氧油主題對**狗**皮膚病變的成功治療，人類患者的幽門螺桿菌感染也可以進行口服治療。

D - Intradiscal椎間盤

The intradiscal route, consists of the O₂ – O₃ mixture application in the altered intervertebral disk space, assisted by radiographic control using the radiological arc mobile or fluoroscopy or computed tomography. Ozone dissolves in the interstitial fluid and reacts with the biomolecules of the local tissue.

內途徑包括在改變的椎間盤間隙中應用 O₂-O₃ 混合物，並使用放射電弧移動或透視或計算機斷層掃描進行放射學控制。臭氧溶解在間質液中並與局部組織的生物分子發生反應。

A cascade of **ROS(Reactive Oxygen Species)** is generated by reacting with the proteoglycans, of the nucleus pulposus, leading to their rupture and degeneration of the matrix with progressive decrease and disappearance of the herniated material. 通過與髓核的蛋白聚糖產生級聯氧氣種類的反應，導致它們破裂和變性基質，伴隨著疝出物質的逐漸減少和消失。

Because of the reduction of mechanical irritation, the sensitivity of axons decreases, although there are other mechanisms of pain in disk disease and spinal cord lesions (BOCCI et al., 2015).

由於機械刺激的減少，軸突的敏感性降低，儘管椎間盤疾病和脊髓病變還有其他疼痛機制

The intradiscal route can be performed by using a 2.5 inch 22 G spinal needle inserted through the skin and epaxial muscles and positioned from the lateral side of the articular facet to the center of the herniated disk.

椎間盤內途徑可以通過使用一根 2.5 英寸 22 G 穿過皮膚和外軸肌肉進行，並從關節突的外側定位到椎間盤突出的中心。

E Paravertebral 脊柱旁、椎旁

The ozone is immediately produced by a medical device and collected by a syringe. With the help of a 27G scalp or 30 G hypodermic needle (13 x 30mm) is applied to the paravertebral region.

臭氧立即由醫療設備產生並由注射器收集。在 27G 頭皮或 30 G 皮下注射針（13 x 30mm）的說明下，應用於椎旁區域。

It consists of the application of O2 – O3 in the paravertebral region, being minimally invasive, safe, and effective to relieve pain. 它包括在椎旁區域應用 O2 – O3，微創、安全且有效緩解疼痛。

The advantage observed was that this technique is easy to perform especially in small animals and horses, not requiring computed tomography or anesthesia 觀察到的優點是這種技術很容易執行，尤其是在小動物和馬中，不需要計算機斷層掃描或麻醉。

The paravertebral muscles are used as a route for O2–O3 infiltration. A systematic review and meta-analysis of ozone therapy for low back pain secondary to herniated disk indicated the level of evidence is II-3(evidence obtained from diagnostic studies of uncertainty) for ozone therapy applied intradiscally and II-1. 椎旁肌肉用作 O2-O3 浸潤的途徑。一項關於臭氧療法治療繼發於椎間盤突出的腰痛的系統評價和薈萃分析表明，證據級別為 II-3。（從不確定性診斷研究中獲得的證據）用於椎間盤內應用臭氧治療和 II-1。

(evidence obtained from at least one properly conducted diagnostic accuracy study of adequate size) for ozone therapy applied at the paravertebral muscle and perforaminally for long-term pain relief based on USPSTF levels of evidence-based on the quality data available in the literature.

（從至少一項適當進行的足夠規模的診斷準確性研究中獲得的證據）用於基於 USPSTF 的椎旁肌肉和椎間孔周圍臭氧療法以長期緩解疼痛，基於文獻中可用質量數據的證據水準。

The available evidence produced a 1C strength of recommendation (strong recommendation, low quality or very low-quality evidence - may change when higher quality evidence becomes available) for ozone therapy applied to the disk and 1B (strong recommendation, moderate-quality evidence - can apply to most patients in most circumstances without reservation) 現有證據產生了 1C 的推薦強度（強烈推薦、低品質或極低質量證據 - 當獲得更高品質的證據時，可能會發生變化）對於應用於椎間盤和 1B 的臭氧療法（強烈推薦，中等質量證據 - 在大多數情況下可以毫無保留地

適用於大多數患者)

F- Vesicourethral insufflation 、 oxygen insufflation 膀胱尿道注氧法

Direct ozone into vesicourethral is described as inflammatory, neoplasia, interstitial, bacterial, or radiation cystitis. It can be done with an urethral probe. It can be previously combined with ozonated water insufflation.

臭氧直接進入膀胱尿道被描述為炎症性、腫瘤性、間質性、細菌性或放射性膀胱炎。它可以通過尿道管來完成。它以前可以與臭氧水注入結合使用。

Ozone can be used for systemic action and the most common will be described. The local ozone rectal insufflation is also considered systemic, but it has been previously described.

臭氧可用於全身作用，它被描述最常見的。局部臭氧直腸注入也被認為是全身性的，但之前已經描述過。

G - Major ozonated autohemotherapy 臭氧化大自血

The Major ozonated autohemotherapy (MAH) consists of collecting a sample blood volume in a bag containing anticoagulant, then mixing it with O₂-O₃ and administering intravenously.

主要臭氧化大自血療法 (MAH) 包括在裝有抗凝劑的袋子中收集樣本血容量，然後將其與 O₂-O₃ 混合並靜脈內給藥。

Variations in microcirculation and metabolic changes that have been stable over time have been observed, such as an increase in cerebral oxygenation after about 1.5 hours of ozonated blood infusion and an increase in cytochrome c oxidase activity and concentration for up to 40 min after the end of treatment.

已經觀察到隨著時間的推移而穩定的微迴圈和代謝變化的變化，例如臭氧化血液輸注約 1.5 小時後腦氧合增加，以及治療結束後長達 40 分鐘的細胞色素 c 氧化酶活性和濃度增加。

It is indicated for arterial circulation diseases, infections, rheumatic arthritis, immunostimulation, and carcinoma in geriatric patients. The AMD (dry age-related macular degeneration) has been treated with major ozonated autohemotherapy with a positive influence on visual acuity AMD.

它適用於老年患者的動脈迴圈疾病、感染、風濕性關節炎、免疫刺激和癌症。(乾性年齡相關性黃斑變性) 已接受主要臭氧化自血療法治療，對視力有積極影響。

H - Minor ozonated autohemotherapy 臭氧化小自血

It works as an autovaccine, widely used for immunomodulation. It consists of the application of autologous blood collected through a syringe with previously ozone content. After homogenization of blood with ozone, it is applied intramuscularly or at an acupuncture point with the purpose of immunomodulation.

它作為一種自體疫苗，**廣泛用於免疫調節**。它包括應用通過注射器收集的具有先前臭氧含量的自體血液。**用臭氧使血液混合後，肌肉注射或在穴位施用，以達到免疫調節的目的。**

Indications are in general for dermatological diseases like dermatitis, psoriasis, allergies, and adjuvant for oncological disease and chronic debilitating diseases.

適應症通常用於皮膚病，如皮炎、銀屑病、過敏，以及腫瘤疾病和慢性衰弱性疾病的輔助治療。

The therapeutic ozone dosages are divided according to their mechanism of action and route of application. The low doses are used for immunomodulatory effect and when the immune system is very much compromised, like in neoplasia, elderly and debilitated patients.

治療臭氧劑量根據其作用機制和應用途徑進行劃分。

低劑量用於免疫調節作用和當免疫系統嚴重受損時，如腫瘤、老年人和虛弱患者。

The medium doses are used for immunomodulatory function and can stimulate the antioxidant enzyme defense system. It is indicated for chronic degenerative diseases such as diabetes, atherosclerosis, chronic obstructive pulmonary disease (COPD), Parkinson's syndrome, Alzheimer's, and senile dementia.

中等劑量用於免疫調節功能，可刺激抗氧化酶防禦系統。它適用於慢性退行性疾病，如糖尿病、動脈粥樣硬化、慢性阻塞性肺病（COPD）、帕金森綜合征、阿爾茲海默氏症和老年性失智。

The high doses are used for the inhibitory effect on the mechanisms, which occur in autoimmune diseases like rheumatoid arthritis and lupus, or to treat ulcers or infected injuries Other routes of ozone administration can be used such as intra-articular, subcutaneous, paratendon, and trigger points.

高劑量用於對自身免疫性疾病（如類風濕性關節炎和狼瘡）中發生的機制的抑製作用，或用於治療潰瘍或感染性損傷可以使用其他臭氧給藥途徑，例如關節內、皮下、肌腱旁和觸發點。

CONTRAINDICATIONS, SIDE EFFECTS, AND CARE 禁忌症、副作用和護理

Contraindications for the use of ozone in humans are described, such as Glucose-6-Phosphate-Dehydrogenase deficiency (Favism, acute hemolytic anemia), hemochromatosis, toxic hyperthyroidism (Basedow-Graves' disease). In severe thrombocytopenia in humans, it is recommended not to use when below 50,000

platelets.

描述了在人類中使用臭氧的禁忌症，例如葡萄糖-6-磷酸-脫氫酶缺乏症（**Favism**，急性溶血性貧血），血色素沈著病，中毒性甲狀腺功能亢進症（**Basedow-Graves 病**）。

在人類嚴重血小板減少症中，建議血小板低於 **50,000** 時不要使用。

Also, if there is severe cardiovascular instability, acute myocardial infarction, alcohol intoxication, treatment with iron or copper, and seizure status it is not recommended the ozone application.

此外，如果存在嚴重的心血管不穩定、急性心肌梗塞、酒精中毒、鐵或銅治療以及癲癇發作狀態，則不建議使用臭氧。

There are no studies in veterinary medicine to establish the recommended limits.

獸醫學中沒有研究來確定建議的限值

Minor autohemotherapy applied at an acupuncture point - GV14, localized between C7 -T1 vertebrae for immunological modulation.

在穴位應用的小型自血療法 - GV14，位於 C7 -T1 椎骨之間以進行免疫調節。

The dog had seizures (suspected immune-mediated etiology) and thoracolumbar disk disease. 這隻狗患有癲癇發作（疑似 immune 介導的病因）和胸腰椎間盤疾病。

Acta Veterinaria Brasilica 巴西獸醫學報

Ozone therapy in veterinary medicine: clinical indications and techniques

獸醫學中的臭氧治療：臨床適應症和技術

The incidence of side effects of ozone therapy-related in literature is very low, estimated at 0.0007%. 文獻中臭氧療法相關副作用的發生率非常低，估計為 **0.0007%**。

One can manifest euphoria, nausea, headaches, and fatigue. One must take care during the use of ozone and not direct inhale it because it is toxic to the upper airway and lungs. Signs of epiphora, rhinitis, cough, headache, and less common, nausea and vomiting are side effects.

一個人可以表現出不適、噁心、頭痛和疲勞。使用臭氧時必須小心，**不要直接吸入臭氧**，因為它對上呼吸道和肺部有毒。癥狀包括耳炎、鼻炎、咳嗽、頭痛，以及不太常見的噁心和嘔吐是副作用。

Important interactions with ozone are the antioxidants, like vitamin C and E, so they must be administered before or after ozone therapy, not during the therapy, because of the interference with ozone mechanisms of action and results. Ozone increases the effects of angiotensin-converting enzyme inhibitors.

與臭氧的重要相互作用是**抗氧化劑**，如**維生素 C 和 E**，因此它們必須在臭氧治療之前或之後

給藥，而不是在治療期間給藥，因為會干擾臭氧的作用機制和結果。臭氧會增加血管緊張素轉換酶抑制劑的作用。

Treatment with copper and iron is contraindicated together with ozone therapy. However, synergic effects are observed with laser, magnetic therapy, acupuncture, and diathermy.

銅和鐵治療與臭氧治療是禁忌的。然而，與鐳射、磁療、針灸和透熱療法觀察到協同效應。

Overall, it is a safe therapy if applied correctly with the recommended dose, avoiding complications with air embolism using the correct practice and certified equipment

總體而言，如果以推薦劑量正確應用，這是一種安全的療法，使用正確的做法和經過認證的設備避免空氣栓塞併發症。

POSSIBILITIES OF CLINICAL INDICATIONS臨床適應症的可能性

In small animals, the great application of ozone therapy has been in pain control , intervertebral disk disease, arthropathies , dermatopathies and in the treatment of infectious diseases such as ehrlichiosis, leishmaniasis, and feline viral immunodeficiency . 在小動物中，臭氧療法的重要應用是 疼痛控制 、椎間盤疾病、關節病 、皮膚病以及治療埃立克體病、利什曼病和貓病毒免疫缺陷等傳染病。

In large animals, in addition to diseases common to small animals such as arthropathies, disk disease, and treatment of pain and wounds in horses , mastitis and reproductive disorders in domestic ruminants. A chronic increase in oxidative stress is seen in serious conditions such as myocardial infarction, stroke, chronic limb ischemia, COPD, type II diabetes, and AMD.

在大型動物中，除了小動物常見的疾病如關節病、椎間盤疾病以及治療馬的疼痛和傷口外，家反芻動物的乳腺炎和生殖障礙。氧化應激的慢性增加見於心肌梗塞、中風、慢性肢體缺血、慢性阻塞性肺病、II 型糖尿病和 AMD 等嚴重疾病。

Initial inflammation occurs followed by excessive release of ROS, causing a diffuse cell injury that must be corrected by an inducible expression of the innate detoxifying and antioxidant system.

最初的炎症發生后，ROS 過度釋放，導致瀰漫性細胞損傷，必須通過先天解毒和抗氧化系統的誘導表達來糾正。

ROS could activate the transcription factor (nuclear factor erythroid 2-related factor 2) Nrf2, which increases the expression of antioxidant enzymes. Nrf2 could be activated by ozone therapy, and when properly activated, can restore redox homeostasis, and possibly improve health.

ROS 可以啟動轉錄因數（核因數紅細胞 2 相關因數 2）Nrf2，從而增加抗氧化酶的表達。Nrf2 可以通過臭氧療法啟動，如果啟動得當，可以恢復氧化還原穩態，並可能改善健康。

Reports of studies with various diseases **in animals** have demonstrated the effect of ozone therapy in neutralizing oxidative stress such as an improvement in the antioxidant capacity after MAH application in thoroughbred **horses**, cisplatin-induced nephrotoxicity, reduced lipid and protein oxidation markers and decreased lipofuscin pigment deposition in **rat** liver and kidneys in a pre-aging ozone administration, reperfusion injury of hepatic and renal ischemia and diabetic nephropathy and improvement in neurodegenerative changes in the cerebral cortex in **rats**.

動物中各種疾病的研究報告表明，臭氧療法在中和氧化應激方面的作用，例如在純種馬中使用 MAH 後抗氧化能力的提高，順鉑引起的腎毒性、降低脂質和蛋白質氧化標記物以及減少衰老前臭氧給藥中大鼠肝臟和腎臟中脂褐素的沉積、肝腎缺血和糖尿病腎病的再灌注損傷以及大鼠大腦皮層的神經退化性變的改善。

The most frequent animal diseases treated with ozone therapy and their most common application routes can be seen elsewhere.

臭氧療法治療的最常見動物疾病及其最常見的應用途徑可以在其他地方看到。

For example, gastrointestinal diseases, pancreatitis, chronic gastroenteritis, anemias, and immune-mediated thrombocytopenias with Ht >20% and acute and chronic kidney disease could have the ozone application route like major autohemotherapy, minor autohemotherapy, and rectal insufflation.

例如，胃腸道疾病、胰臟炎、慢性胃腸炎、貧血、Ht > 20% 的免疫介導性血小板減少症以及急性和慢性腎臟疾病，可以採用臭氧應用途徑，如大自體血療法、小自體血療法和直腸注入療法。

Ozone therapy is described in the treatment of neurodegenerative diseases such as Multiple Sclerosis, Parkinson's disease, Alzheimer's and Wilson's disease, amyotrophic lateral sclerosis, Huntington's disease, and cognitive disorders.

臭氧療法可用於治療多發性硬化症、帕金森氏症、阿茲海默症、威爾森氏症、肌萎縮側索硬化症、亨丁頓舞蹈症和認知障礙等神經退化性疾病。

Its effect can be explained by its neuroprotective action, minimizing the effects of oxidative stress in these pathologies.

其作用可以透過其神經保護作用來解釋，最大限度地減少這些病理中氧化壓力的影響。

For example, studies in rats have shown that intraperitoneal application therapy with controlled ozone induces oxidative preconditioning, thus reversing oxidative stress, with an improvement in neurodegenerative changes in the cerebral cortex of elderly rats.

例如，對大鼠的研究表明，腹膜內應用控制臭氧療法可誘導氧化預處理，從而逆轉氧化應激，改善老年大鼠大腦皮質的神經退化性病變。

Inflammatory and infectious diseases 炎症和感染性疾病

Recently, cohort studies and case reports using ozone therapy as a complementary treatment have been published in patients diagnosed with the pandemic virus COVID-19. The articles describe the ozone techniques used: major autohemotherapy, intramuscular application, rectal insufflation and intravenous ozonized saline solution.

最近，針對確診感染大流行病毒 COVID-19 的患者，發表了使用臭氧療法作為補充治療的隊列研究和病例報告。文章描述了所使用的臭氧技術：主要自體血療法、肌肉注射、直腸充氣和靜脈注射臭氧鹽水溶液。

In these studies, improvement in symptoms such as dyspnea, weakness, and decrease in body temperature was observed and corresponded to an improvement in chest radiographic findings, oxygen saturation, and laboratory findings due to the decrease in inflammation markers.

在這些研究中，觀察到呼吸困難、虛弱和體溫下降等症狀的改善，並且由於發炎標記物的減少，胸部 X 光片結果、血氧飽和度和實驗室結果也得到改善。

A reduction in mortality was seen and side effects were not noticed 300 Acta Veterinaria Brasilica December 16 (2022) 294-304 Sumida et al.

死亡率降低，未發現副作用

A twice-daily ozonated autohemotherapy for 5 consecutive days in 18 human patients with COVID-19 severe pneumonia was associated with a significant reduction in the time of clinical improvement.

對 18 名 COVID-19 重症肺炎患者連續 5 天進行每天兩次臭氧自體血療法，可顯著縮短臨床改善時間。

Some reports related good results on ozone therapy for inflammatory and infectious diseases in **veterinary medicine**.

一些報告介紹了**獸醫學**中臭氧療法治療炎症和傳染病的良好結果。

An application of rectal ozone insufflation in **animals** with positive PCR for canine parvovirus study, demonstrated 20 times higher mortality in the control group when compared to the **dogs** of the treated group. 對**犬**小病毒 PCR 檢測呈陽性的動物進行直腸臭氧注入研究，結果顯示對照組的死亡率是治療組狗的 20 倍。

Garcia et al. (2010) reported the use of ozonated MAH in canine ehrlichiosis treatment. This therapy was effective in reversing different hematological parameters and improving renal damage.

Garcia 等人（2010 年）報告了使用臭氧化 MAH 治療犬埃立克體病。此療法可有效逆轉不同的血液學參數並改善腎臟損傷。

The use of ozone therapy as an adjuvant treatment for visceral leishmaniasis is described by Moda et al. (2014). Infected **dogs** undergoing rectal insufflation treatment showed a decrease in serum urea and creatinine values at the end of treatment, showing better performance than the intra-abdominal treatment.

Moda 等人（2014）描述了使用臭氧療法作為內臟利什曼病的輔助治療。接受直腸注入治療的感染**犬**在治療結束時血清尿素和肌酸酐值下降，比腹腔內治療效果更好。

Kawahara et al. (2019) described the successful treatment of a **cat** with feline viral immunodeficiency with ozone therapy using minor and major autohemotherapy and rectal insufflation. No side effects were observed.

Kawahara 等人（2019）描述了使用臭氧療法（採用小劑量和大劑量自體血療法以及直腸注入）成功治療患有**貓**病毒性免疫缺陷的貓。未觀察到副作用。

Musculoskeletal diseases 肌肉骨骼疾病

Avilés (2013), studied the anti-inflammatory and analgesic effects of ozone and growth factors derived from ozone-activated platelets in dogs with osteoarthritis in the hips and with spinal pain or pain in the extremities. O₂-O₃ was applied in the periarticular region and painful paravertebral regions, resulting in a significant improvement.

Avilés（2013）研究了臭氧和源自臭氧活化血小板的生長因子對患有髖部骨關節炎、脊椎疼痛或四肢疼痛的犬隻的抗發炎和鎮痛作用。在關節周圍區域和疼痛的椎旁區域應用 O₂-O₃，結果顯著改善了症狀。

An experimental study in **horses** evaluated the transient inflammatory reactions induced by intra-articular administration of medicinal ozone affecting joint components, by in vivo inflammatory evaluation, anti-inflammatory, and oxidative biomarkers, and extracellular matrix degradation products in synovial fluid in healthy **horse's** joints.

一項針對馬的實驗研究透過體內發炎評估、抗發炎和氧化生物標記以及健康馬關節滑液中的細胞外基質降解產物，評估了關節內注射藥用臭氧對關節成分引起的瞬時發炎反應。

Analyzes of synovial fluid did not reveal significant changes in the concentrations of the main biomarkers of cartilage inflammation and catabolism, indicating that intra-articular application of medicinal ozone in **horses** seems to be safe (VENDRUSCOLO et al., 2018).

滑液分析未發現軟骨發炎和分解代謝的主要生物標記濃度發生顯著變化，這表明在馬的關節內應用藥用臭氧似乎是安全的（VENDRUSCOLO 等人，2018 年）。

Another study verified the action of ozone therapy application on an experimental model of rheumatoid arthritis in **Wistar rats**. It was observed effectively reduced inflammation through the reduction of pro-inflammatory cytokines and activation of IL-10 anti-inflammatory cytokine (TARTARI et al., 2020).

另一項研究驗證了臭氧療法對 **Wistar** 大鼠類風濕性關節炎實驗模型的作用。研究觀察到，臭氧療法透過減少促發炎細胞因子和活化 IL-10 抗發炎細胞因子，有效減輕發炎。

Coelho et al. (2015), reported a **mare** case diagnosed with chronic laminitis (grade IV according to Obel) with signs of lameness and reluctance to walk, radiographic measurements revealed displacement of the distal phalanx. Corrective cutting and administration of O₂-O₃ (intramuscularly, peritendinous and rectal insufflation) was performed.

Coelho 等人（2015 年）報告了一例被診斷患有慢性蹄葉炎（Obel 分級為 IV 級）的**母馬**病例，該馬有跛行和不願行走的跡象，X 射線測量顯示遠端指骨移位。進行了矯正切割和 O₂ - O₃ 給藥（肌肉注射、韌鞘周圍和直腸注入）

The animal showed improved body condition, and better ambulation and the radiological evaluation after treatment showed a normal relationship between the dorsal hull wall.

該動物的身體狀況有所改善，行走能力有所提高，治療後的放射學評估顯示背部船壁之間的關係正常。

Intervertebral disk diseases 椎骨間的、盤狀物、疾病

For the treatment of disk disease, two methods are described: direct and indirect. The direct method consists of an intradiscal application and the indirect method, in a paravertebral application. This last form is also considered chemical acupuncture, due to the beneficial results being obtained with the application of ozone as a chemical reagent through the insertion of the needle.

對於椎間盤疾病的治療，描述了兩種方法：直接和間接。直接方法包括椎間盤內應用和間接方法（包括椎旁應用）。最後一種形式也被認為是化學針灸，因為插入針頭使用臭氧作為化學試劑可以獲得有益的效果。

The role of this technique is related to obtaining a complex series of neurological and chemical reactions that lead to decreased pain in the majority of patients with pain in the spine, with positive responses in 70-80% of cases.

該技術的作用在於獲得一系列複雜的神經和化學反應，從而減輕大多數脊椎疼痛患者的疼痛，其中 70%-80% 的病例出現積極反應。

In an observational and prospective study realized in humans in Guantanamo, ozone therapy was applied paravertebrally in diseases of the spine. Most patients moved to a lower pain category and 80.7% were evaluated in the mild-moderate category after ozone therapy.

在關塔那摩進行的一項針對人類的觀察性和前瞻性研究中，臭氧療法被應用於脊椎疾病的椎旁治療。大多數患者在臭氧治療後轉移到較低的疼痛類別，80.7% 的患者被評估為輕度至中度類別。

The effects of the application of intradiscal and paravertebral ozone are: inhibition of prostaglandin E2 and phospholipase A2, similar to steroids; inhibition of other pro-inflammatory cytokines (IL 1, 2, 8, 12, 15, interferon- α); (IL 1, 2, 8, 12, 15, interferon- α); increased release of immunosuppressive cytokines (IL10, factor B1) producing analgesic and anti-inflammatory effects; increase of local microcirculation; reduce venous stasis and hypoxia in the nerve root producing an analgesic effect; effect on the mucopolysaccharides and proteoglycans of the nucleus pulposus, which is called ozonolysis, producing a chemical discolysis with the loss of water and dehydration; matrix degeneration, which is replaced by collagen fibers reducing the volume of the disk (SCHWARTZ; SANCHEZ, 2012).

椎間盤內和椎旁應用臭氧的作用是：抑制前列腺素 E2 和磷脂酶 A2，類似類固醇；抑制其他促發炎細胞激素（IL 1、2、8、12、15，干擾素- α ）；（IL 1、2、8、12、15，干擾素- α ）；增加免

疫抑制細胞激素（IL10，因子 B1）的釋放，產生鎮痛和抗發炎作用；增加局部微循環；減少神經根的靜脈淤滯和缺氧，產生鎮痛作用；對髓核的黏多醣和蛋白多醣的作用，稱為臭氧分解，產生化學性椎間盤溶解，失水和脫水；基質變性，被膠原纖維所取代，從而減少了椎間盤的體積（SCHWARTZ；SANCHEZ，2012）。

Han et al. (2007), reported the percutaneous application of intradiscal O2–O3 guided by fluoroscopy in **dogs** with thoracolumbar disk disease. A significant reduction of the intervertebral disk volume was observed in computed tomography and **all dogs** recovered their gait function and did not present recurrence.

Han 等 (2007) 報告了在 X 光透視引導下經皮椎間盤內 O2 – O3 治療**犬**胸腰椎間盤疾病。CT 檢查顯示椎間盤體積顯著減少，**所有犬** 步態功能均恢復，且未復發。

Jang et al, (2009) described the application of ozone on a **Shih-Tzu dog** with spinal cord compression in the cervical region and presenting progressive tetraplegia. O2–O3 was applied intraoperatively in the affected intervertebral spaces together with ventral decompression surgery in the intervertebral space. After the procedure, there was no more cervical pain and complete resolution of neurological deficits. Jang 等人（2009）描述了將臭氧應用於一隻頸部脊髓受壓並出現進行性四肢癱瘓的**西施犬**。術中對受累椎間隙應用 O2 – O3，同時對椎間隙進行腹部減壓手術。手術后，宮頸疼痛不再存在，神經功能缺損完全消退。

廖品嫻 Nancy Liao

Cell:0963-833-707

生凱有限公司

Line: ozonehelps;

WhatsApp: Nancy Liao

Email:ozonehelps@gmail.com

www.ozonehelps.com