Kyselina chlórna (Veterinol) a jej využitie vo veterinárnej praxi

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Kľúčové slová: kyselina chlórna (HOCl), Gram pozitívne baktérie, Gram negatívne baktérie, mikroskopické vláknité huby (mikromycéty), vírusy, veterinárna prax

Veterinol je superoxidovaný, netoxický a nedráždivý prostriedok vo forme roztoku, alebo gélu, ktorý sa používa na čistenie, zvlhčovanie a ošetrovanie akútnych a chronických rán, abscesov, popálenín a odrenín u všetkých druhov zvierat. Znižuje mikrobiálnu záťaž rán a napomáha vytvoreniu vlhkého prostredia v rane, čím umožňuje organizmu rozvinúť vlastný proces hojenia. Účinnou látkou Veterinolu je kyslík a kyselina chlórna (HOCl). Kyselina chlórna je jednou z hlavných zložiek, ktorú využíva imunitný systém zvierat pri likvidácii patogénov (baktérie, vírusy, mikromycéty). **Wang et al. (2007) vo svojom článku napísali, že kyselina chlórna (HOCl), hlavná anorganická baktericídna zlúčenina vrodenej imunity, je účinná proti širokému spektru mikroorganizmov.**

Pozoruhodnou vlastnosťou imunitného systému je jeho schopnosť spustiť účinnú odpoveď proti inváznym patogénom nasadením skupiny vysoko reaktívnych chemikálií, vrátane oxidovaných halogénov, oxidačných radikálov a singletového kyslíka (Weiss, 1983; Kettle, 1997). Prekurzorom týchto reaktívnych foriem kyslíka (ROS) je kyslíkový radikál (O2), ktorý vytvárajú špecializované imunitné bunky – neutrofily, eozinofily, mononukleárne fagocyty a B lymfocyty (Babior, 1978; Kettle, 1997). **Je známe, že HOCl je hlavným silným oxidačným činidlom produkovaným neutrofilmi a je silným mikrobicídnym činidlom v týchto bunkách (Weiss, 1983; Aratani, 2006).**

Biele krvinky – konkrétne neutrofilné granulocyty, produkujú za normálnych okolností dostatočné množstvo kyseliny chlórnej, ktorá má úžasnú schopnosť

prenikať hlboko do telesných tkanív, kde pri jej kontakte s patogénmi ich zneškodní. Pri procese likvidácie patogénov uvoľní kyselina chlórna biologicky aktívny kyslík, ktorý ich chemickým pôsobením – oxidáciou, deštruuje. Experimentálne sa odhadlo, že 10 neutrofilov stimulovaných in vitro môže produkovať 0,1 μM HOCl (Brinkmann et al., 2004). Toto množstvo HOCl môže zabiť 1,5 x 10^7 *Escherichia coli* za menej ako 5 minút (Lapenna et al., 1996). HOCl ľahko reaguje s celým radom biologických molekúl, najmä s tiolovými, tioléterovými, hemovými proteínmi a aminoskupinami (Vissers et al., 1995) a môže viesť k poškodeniu tkaniva. Taurín, neesenciálna aminokyselina, ktorá sa prirodzene nachádza v koncentrácii približne 15 mM v neutrofiloch, pôsobí ako vychytávacia molekula pre HOCl a účinne tlmí vedľajšie poškodenie bunkových makromolekúl spôsobené HOCl (Klamt et al., 2005). **Ako bolo uvedené vyššie, HOCl likviduje aj vírusy,** pri kontakte s ktorými dezinfekčné činidlo zmení ochranný proteínový obal, ktorý stratí svoju štruktúru a zhlukuje sa, čím sa vytvárajú zhluky proteínov s inými vírusmi (Cottone et al., 1996; Doremalen et al., 2020). V súčasnosti americká agentúra na ochranu životného prostredia odporučila množstvo dezinfekčných prostriedkov proti COVID-19 vrátane kyseliny chlórnej (HOCl) (US Environmental Protection Agency, 2020). Mechanizmus dezinfekcie HOCl zahŕňa zničenie bunkovej steny mikróbov alebo vírusov, čo umožňuje dezinfekčnému prostriedku ich zničiť alebo inaktivovať (Moggio et al., 1979; Goldner et al., 1980; Wolfe, 1990; Lidwell, 1994; McDonnell et al., 1999; Xu et al., 2005; Chen et al., 2006; Menetrez et al., 2010; Reed, 2010; Nerandzic et al., 2015; Ding et al., 2016; Weber et al., 2016; Hagbom et al., 2017; Health Quality Ontario, 2018; Cadnum et al., 2020; Suman et al., 2020).

Germicídne vlastnosti HOCl boli dobre opísané (McKenna et al., 1988; LaPenna et al., 1996; Kettle et al., 1997; White, 1999; Bowler et al., 2001; Aratani et al., 2006).

Kyselina chlórna sa používa ako dezinfekčný prostriedok, napríklad pri dezinfekcii umývacích roztokov a bazénov. V týchto aplikáciách sa reaktívna chemikália tvorí v roztoku pridaním chlóru do vody. Podobne sa HOCl používa na úpravu pitnej vody a vzniká po pridaní plynného chlóru alebo NaOCl (Wang et al., 2007). Kyselina chlórna (HOCl) zahŕňa mnohé z požadovaných účinkov ideálneho dezinfekčného prostriedku: ľahko sa používa, je lacná, má dobrý bezpečnostný profil

a možno ju použiť na rýchlu dezinfekciu veľkých plôch so širokým rozsahom baktericídnych a virucídnych účinkov (Block et al., 2020).

V porovnávacích štúdiách Wang et al. (2007) preukázali, že H2O2 a chlórnan (NaOCl) sú účinné proti určitým baktériám (účinnejšie proti gramnegatívnym baktériám, ale nie grampozitívnym baktériám). Tieto rozsahy účinných antimikrobiálnych koncentrácií však začínajú korelovať s vyššou cytotoxicitou na bunky cicavcov v porovnaní s HOCl. Tento antiseptický profil NaOCl sa podobá niektorým voľne predajným antiseptikám: dusičnanom strieborným alebo strieborným iónom, betadínu a kyseline octovej (údaje nie sú uvedené). Okrem toho existujú ďalšie antiseptiká, ktoré sú menej toxické pre bunky cicavcov, ale zároveň majú nižšiu antimikrobiálnu aktivitu (etanol, peroxid vodíka a 5 % roztok mafenidacetátu) v porovnaní s HOCl (údaje nie sú uvedené). Ministerstvo zdravotníctva a sociálnych služieb autorovej krajiny neodporúča používať bežne používané antiseptické roztoky na liečbu infekcií rán vo všeobecnosti a najmä chronických nehojacich sa rán, pretože z vyššie uvedených dôvodov je ich použitie kontraindikované. Údaje prezentované v ich štúdii by preto mali pomôcť pri výbere bezpečnejších antimikrobiálnych činidiel na dezinfekciu rán, výplachy a obväzy. Toto prehodnotenie nahromadených dôkazov má slúžiť ako základ, ktorý má pomôcť odborníkom robiť informované rozhodnutia pri výbere vhodného lokálneho antimikrobiálneho činidla na liečbu rán (Wang et al., 2007). Keďže vývoj bakteriálnej rezistencie voči antibiotikám pokračuje a polemika o používaní lokálnych antiseptík pretrváva, kriticky nevyhnutným sa stáva potreba výskumu a vývoja nových tried antimikrobiálnych činidiel, ktoré sú bezpečné a široko účinné a majú nízku toxicitu a nízky sklon k vyvolaniu antimikrobiálnej rezistencie. V súčasnosti ministerstvo zdravotníctva a sociálnych služieb v autorovej krajine neodporúča používanie širokospektrálnych lokálnych antibiotík na liečbu rán, ktoré sa neliečia, alebo u ktorých existuje riziko infekcie (Bergstrom et al., 1994). Tieto odporúčania sú založené na nasledujúcich dôvodoch: antibiotiká môžu spôsobiť alergické reakcie; najmä pri lokálnej aplikácii môžu mať nižšiu distribúciu v tkanivách; väčší účinok na endogénnu mikroflóru (narušenie normálnej komenzálnej mikrobioty); vyvolať rezistenciu; a prípadne majú zníženú terapeutickú účinnosť. Z rovnakého dôvodu sa neodporúčajú antiseptiká z dôvodu ich vyššej toxicity, potenciálneho rozvoja rezistencie (ako antibiotiká) a čo je dôležitejšie, priameho vplyvu na proces hojenia rán (Wang et al., 2007). Vo svetle

publikovaných výsledkov o HOCl a údajov získaných v rámci výskumov autorov Wang a kol. (2007), teda existuje dostatok presvedčivých dôkazov, ktoré ukazujú, že formulácia HOCl, ktorá sa podobá molekule HOCl vytvorenej neutrofilmi počas oxidačného vzplanutia (prirodzený obranný proces proti invazívnym mikroorganizmom), by sa mohla hodiť na bezpečné a účinné spôsoby liečby infekcie. Vzhľadom na širokospektrálnu, rýchlo pôsobiacu antimikrobiálnu aktivitu HOCl by bola šanca na rozvoj rezistencie minimálna a na základe bezpečnostného profilu HOCl je potenciál pre vedľajšie poškodenie infikovaných tkanív tiež veľmi nízky (Wang et al., 2007).

Podobne má Veterinol (kyselina chlórna) vo veterinárnej praxi široké využitie na každodennej báze, jednak ako dezinfekčný prostriedok napr. pri príprave operačného poľa u zvierat, toalete rán, ale aj ako liečebný prostriedok, pri aplikácii na infekčné rany (absces, nekróza tkaniva), popáleniny a dermatitídy rôznej etológie. Jeho neodmysliteľnou úlohou je nielen výrazné zníženie mikrobiálnej populácie mikroorganizmov v rane, ale aj zmiernenie zápalovej reakcie a celkovo výrazné zlepšenie vzhľadu rany častokrát už po prvej aplikácii (nepublikované údaje z veterinárnej praxe Dudriková MVDr.,PhD., K.; Mičuchová MVDr., L.; Boldižárová MVDr., Z.; Poláková MVDr., PhD. Z.; Pošvanc MVDr., P.;)

Ďalším výrazným účinkom je zmiernenie pruritu pri atopickej dermatitíde u zvierat, ako aj pri niektorých infekčných ochoreniach kože, ktoré sa prejavujú svrbením (nepublikované údaje z veterinárnej praxe Dudriková, K.). K rovnakým zisteniam došli aj autori Draelos a kol. (2012) a to, že HOCl môže znížiť svrbenie buď prostredníctvom svojich mikrobicídnych účinkov na kožné patogény (najmä *Staphylococcus aureus*) pri atopickej dermatitíde, alebo prostredníctvom svojich protizápalových účinkov - najmä zníženie aktivity histamínu, LTB4 a IL-2, všetkých ktoré sa podieľajú na patofyziológii pruritu (Garibyan et al., 2013; Yosipovitch et al., 2008; Friedman et al., 2013). HOCl však môže podporovať svrbenie zvýšením aktivity NGF (nerve growth factor) (Greaves, 2010). Dlhodobá expozícia, alebo vysoké dávky HOCl môžu tiež podporovať pruritus, ako nežiaduci účinok spôsobením dráždivej kontaktnej dermatitídy, alebo menej často alergickej kontaktnej dermatitídy (čo je hypersenzitívna reakcia typu IV) (Hostynek et al., 1989), avšak dosiaľ sa to vo veterinárnej praxi nepopísalo, buď z dôvodu absencie takejto

alergickej reakcie, alebo z dôvodu nedostatočných údajov.

V neposlednej rade najlepšou vlastnosťou Veterinolu je fakt, že zvieratá ho aj napriek slabému zápachu po chlóre a mierne slanej chuti výborne tolerujú. Aplikácia Veterinolu do rany nie je nikdy bolestivá, neštípe ich, tolerujú roztok aj pri aplikácii na sliznice a ochotne znášajú aj opakovanú starostlivosť, čo teší predovšetkým ich majiteľov (nepublikované údaje z veterinárnej praxe Dudriková MVDr.,PhD., K.; Mičuchová MVDr., L.; Boldižárová MVDr., Z.; Poláková MVDr., PhD. Z.; Pošvanc MVDr., P.;). Aplikácia Veterinolu (HOCl) do očí, uší, na sliznice a kožu, ako aj užívanie *per os* nespôsobuje u zvierat žiadnu iritáciu a intoxikáciu. K rovnakým záverom došli aj autori článku Wang et al., (2007), ktorí sledovali okrem iného aj toxicitu a bezpečnosť pri aplikácii u zvierat. Zistilo sa, že stabilizovaná HOCl nedráždi oko králika a je nesenzibilizujúca na zvieracích modeloch (morča). Po instilácii 0,013 % HOCl do očí holandských pigmentovaných králikov každých 8 hodín počas 72 hodín nebolo pozorované žiadne podráždenie očí. Stabilizovaná HOCl v koncentráciách 0,01 %, 0,03 % a 0,10 % w/v v štandardnej štúdii dermálnej senzibilizácie podľa Buehlera u morčiat nepreukázala žiadne známky dermálnej reakcie. Podobne, 28-dňové štúdie toxicity na poranených potkanoch a miniprasiatkach s dennou aplikáciou stabilizovaného HOCl v množstve 0,01 %, 0,03 % a 0,1 % w/v spolu s 24-hodinovým uzavretým obväzom nepreukázali žiadny dôkaz systémovej toxicity. Mikroskopické vyšetrenie oblasti rany ukázalo očakávané známky zranenia a následnej reparácie rany (Wang et al., 2007).

Existuje veľa klinických štúdií, prevažne v humánnej oblasti, o používaní kyseliny chlórnej (HOCl), či už ako dezinfekčného agens na plochy, nástroje a medicínske vybavenie, alebo ako terapeutika v rôznych oblastiach medicíny, napr. v gynekológii, chirurgii, stomatológii, plastickej chirurgii a dermatológii. Vo veterinárnej medicíne je množstvo zmienok v boji napr. voči aviárnej influenze (Hakim et al., 2014), bovinnej keratokonjunktivitíde (Garde t al., 2016) a mnoho ďalším ochoreniam. HOCl sa dokonca preukázala ako vynikajúci dezinfekčný prostriedok v boji s najnovšou nákazou tohto storočia a to COVID-19. V našom lokálnom veterinárnom časopise (Infovet) sa HOCl a jej využitie popisuje v jednotlivých klinických štúdiách v terapii rán u rôznych druhov zvierat u konkurenčného prípravku s obsahom HOCl.

Ako veterinárneho lekára v každodennej praxi ma účinnosť kyseliny chlórnej v prípravku Veterinol neustále prekvapuje, stále prichádzam na niečo nové. Veterinol mi pomáha udržiavať prístrojové vybavenie a plochy ambulancie čisté, aplikujem ho na kožu pri každom jednom odbere krvi, či zavedením i.v. kanyly, pred operáciou pri aseptickej príprave operačného poľa, aplikujem ho na rany rôznej etiológie, používam ho ako súčasť terapie pri konjunktivitídach a to najmä u mačiek pri herpese, pri bakteriálnych gingivitídach u psov a kaliciviróze u mačiek, aplikujem ho do hrdla v prípade syndrómu kotercového kašľa u psov, pri chirurgických výkonoch mi zastavuje mierne krvácanie z podkožia, pri dermatitídach a mnoho ďalších.

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Chloric acid (Veterinol) and its use in veterinary practice

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Key words: hypochlorous acid, Gram positive bacteria, Gram negative bacteria, fungi = microscopic filamentous fungi (micromycetes), viruses, veterinary practice,

Veterinol is a superoxidized, non-toxic and non-irritating solution or gel in the form of a solution or gel used for cleaning, moisturizing and treating acute and chronic wounds, abscesses, burns and abrasions in all animal species. It reduces the microbial load of wounds and helps to create a moist environment in the wound, thus allowing the body to develop its own healing process. The active substances in Veterinol are oxygen and hypochlorous acid. hypochlorous acid is one of the main components used by the immune system of animals to eliminate pathogens (bacteria, viruses, micromycetes). L. Wang e al., (2007) wrote in their article, that hypochlorous acid (HOCl), a major inorganic bactericidal compound of innate immunity, is effective against a broad range of microorganisms. A remarkable feature of the immune system is its ability to launch an effective response against invading pathogens by deploying a group of highly reactive chemicals, including oxidized halogens, oxidizing radicals, and singlet oxygen (Kettle et al., 1997; Weiss et al., 1983). The precursor of these reactive oxygen species (ROS) is the oxygen radical (O_2), which is generated by specialized immune cells—neutrophils, eosinophils, mononuclear phagocytes, and B lymphocytes (Kettle et al., 1997; Babior et al., 1978). HOCl is known to be the major strong oxidant produced by neutrophils, and is a potent microbicidal agent within these cells (Weiss et al., 1983; Aratani et al., 2006). As mentioned abbove, white blood cells - specifically neutrophilic granulocytes - normally produce a sufficient amount of hypochlorous acid, which has an amazing ability to penetrate deep into body tissues, where it is neutralized by its contact with pathogens. During the process of eliminating pathogens, hypochlorous acid releases biologically active oxygen, which destroys them by their chemical action - oxidation. Experimentally, it has been estimated that 10 neutrophils stimulated in vitro can produce 0.1 μM HOCl

(Brinkmann et al., 2004). This quantity of HOCl can kill 1.5×10^7 *Escherichia coli* in less than 5 minutes (Lapenna et al., 1996). HOCl reacts readily with a range of biological molecules, particularly those with thiol, thiolether, heme proteins, and amino groups (Vissers et al., 1995), and may lead to tissue injury. Taurine, a nonessential amino acid naturally found at roughly 15 mM within neutrophils acts as a scavenger molecule for HOCl and effectively dampens the collateral damage to cellular macromolecules caused by HOCl (Klamt et al., 2005). As mentioned above, HOCl also kills viruses, upon contact with which the disinfectant alters the protective protein coat, which loses its structure and clumps together, forming clumps of proteins with other viruses (Cottone et al., 1996; Doremalen et al., 2020). Currently, the US Environmental Protection Agency has recommended a number of disinfectants against COVID-19, including hypochlorous acid (HOCl) (US Environmental Protection Agency). The mechanism of disinfection involves destroying the cell wall of microbes or viruses, which allows the disinfectant to destroy or inactivate them (Suman et al., 2020; Chen et al., 2006; Hagbom et al., 2017; McDonnell et al., 1999; Ding et al., 2016; Wolfe, 1990; Xu et al., 2005; Weber et al., 2016; Health Quality Ontario, 2018; Nerandzic et al., 2015; Lidwell, 1994; Menetrez et al., 2010; Moggio et al. al., 1979; Goldner et al., 1980; Reed, 2010; Cadnum et al., 2020). The germicidal properties of HOCl have been well reported (Kettle et al., 1997; Aratani et al., 2006; LaPenna et al., 1996; White, 1999; McKenna et al., 1988; Bowler et al., 2001). Hypochlorous acid is widely used as a disinfectant, for example, in sanitizing wash solutions and swimming pools. In these applications, the reactive chemical is formed in solution by the addition of chlorine to water. Similarly, HOCl is used to treat drinking water and is formed following addition of chlorine gas or NaOCl. Hypochlorous acid (HOCl) comprises many of the desired effects of the ideal disinfectant: It is easy to use, is inexpensive, has a good safety profile, and can be used to disinfect large areas quickly and with a broad range of bactericidal and virucidal effects (Block et al., 2020).

In their comparative studies, Wang et al. (2007) have demonstrated that H2O2 and hypochlorite (NaOCl) are effective against certain bacteria (more effective against gram negatives, but not gram positives). However, those effective antimicrobial concentration ranges begin to correlate with higher cytotoxicity on mammalian cells, as compared to HOCl. This antiseptic profile of NaOCl resemble some of the over-the-counter antiseptics: silver nitrates or silver ions, Betadine, and

acetic acid (data not shown). Moreover, there are other antiseptics that are less toxic to mammalian cells but at the same time have lower antimicrobial activity (ethanol, hydrogen peroxide, and 5% mafenide acetate solution) as compared to HOCl (data not shown). The Department of Health and Human Services in author ´s country discourages the use of commonly used antiseptic solutions to treat wound infection in general and chronic nonhealing wounds in particular because, for reasons mentioned above, their uses are contraindicated. Therefore data presented in this study should help in selecting safer antimicrobial agents for wound disinfection, irrigation, and dressing. This reevaluation of accumulated evidence is intended as a basis to help practitioners make informed decisions for choosing the appropriate topical antimicrobial for wound care management (Wang et al., 2007). As the development of bacterial resistance to antibiotics continues and controversy regarding the use of topical antiseptics persists, the need for research and development of new classes of antimicrobial agents that are safe and broadly effective and have low toxicity and low propensity to induce antimicrobial resistance becomes inevitably critical. Currently, the use of broad-spectrum topical antibiotics to treat wounds that are failing to heal or those at risk for getting infected is not recommended by the Department of Health and Human Services in author ´s country (Bergstrom et al., 1994). These recommendations are based on the following reasons: antibiotics may cause allergic reactions; especially when applied topically may have lower tissue distribution; greater effect on endogenous microflora (disturbance of the normal commensal microflora); induce resistance; and eventually have reduced therapeutic efficacy. By the same token, antiseptics are not encouraged because of their higher toxicity, potential development of resistance (like antibiotics), and, more important, direct impact on wound healing process (Wang et al., 2007). Efficacy of topical antimicrobial agents in the management of serious infections, for example, biofilm- and catheter-related wounds, particularly when chronic and nonhealing, is inconclusive. These observations vary greatly because of (a) inconsistent in vitro test specifications, (b) use of different animal species models, (c) use of different organisms for determining the efficacy outcome. Therefore, overall results make direct comparisons less than ideal. While in vitro testing is required to select potential agents for clinical trials, these models will never totally mimic in vivo conditions. Thus, in light of published results on HOCl and data obtained in the investigations of authors Wang et al. (2007), there is enough compelling evidence to show that

formulation of HOCl, which resembles the HOCl molecule made by neutrophils during oxidative burst (a natural defense process against invading microorganisms), could lend itself for safe and effective treatment modalities of infection. Because of HOCl's broad-spectrum, fast-acting antimicrobial activity, the chances of developing resistance would be minimal and based on its safety profile the potential for collateral damage to infected tissues is also very low (Wang et al., 2007).

Veterinol (hypochlorous acid) in veterinary practice has a wide use on a daily basis, both as a disinfectant, e.g. in the preparation of the surgical field in animals, wound toilets, but also as a remedy, when applied to infectious wounds (abscess, tissue necrosis), burns and dermatitis of various ethology. Its integral role is not only to significantly reduce the microbial population of microorganisms in the wound, but also to reduce the inflammatory response and overall significant improvement in the appearance of the wound, often after the first application (unpublished data from veterinary practice: Dudriková DVM.,PhD., K.; Mičuchová DVM., L.; Boldižárová DVM., Z.; Poláková DVM., PhD. Z.; Pošvanc DVM., P.).

Another significant effect is the alleviation of pruritus in atopic dermatitis in animals, in some infectious skin diseases that are manifested by itching (unpublished data from veterinary practice Dudriková, DVM., PhD., K). The real findings of Draelos et al. (2012) and that HOCl may reduce pruritus either through its microbicidal effects upon cutaneous pathogens (especially *Staphylococcus aureus)* in atopic dermatitis or through its anti-inflammatory effects (especially reduction in the activities of histamine, LTB4, and IL-2, all of which have been implicated in the pathophysiology of itch (Garibyan et al ., 2013; Yosipovitch et al., 2008; Friedman et al., 2013). However, HOCl may promote pruritus by increasing the activity of NGF (nerve growth factor) activity (Greaves, 2010). Prolonged exposure or high doses of HOCl may also promote pruritus as an adverse effect by causing irritant contact dermatitis, or less commonly allergic contact dermatitis (which is a Type IV hypersensitivity reaction) (Hostynek et al., 1999), but it has not been described in veterinary practice, either due to the absence of such an allergic reaction or due to lack of sufficient data.

Last but not least, its best feature is the fact that the animals, despite the faint odor of chlorine and slightly salty taste, tolerate it well, the application is never painful, does not bite them, tolerate the solution even when applied to mucous membranes and willingly tolerate repeated care, which pleases especially their owners. Application of

Veterinol (HOCl) to the eyes, ears, mucous membranes and skin, as well as oral administration, does not cause any irritation or intoxication in animals. The same conclusions were reached by the authors of Wang et al., (2007), who studied, among other things, toxicity and safety when applied to animals. Stabilized HOCl was found to be non-irritating in the rabbit eye and non-sensitizing in animal models (guinea pigs). After instillation of 0.013% HOCl into the eyes of Dutch pigmented rabbits every 8 hours for 72 hours, no eye irritation was observed. Stabilized HOCl at 0.01%, 0.03%, and 0.10% w / v in a standard Buehler dermal sensitization study in guinea pigs showed no evidence of a dermal response. Similarly, 28-day toxicity studies in injured rats and minipigs with daily application of stabilized HOCl at 0.01%, 0.03% and 0.1% w / v together with a 24-hour closed dressing showed no evidence of systemic toxicity. Microscopic examination of the wound area showed the expected signs of injury and subsequent wound repair (Wang et al., 2007).

There are many clinical studies, mainly in the human field, on the use of hypochlorous acid (HOCl), either as a disinfectant on surfaces, instruments and medical equipment, or as therapeutics in various fields of medicine, whether gynecology, surgery, dentistry and many others. In veterinary medicine, there are a number of mentions in the fight, e.g. against avian influenza (Hakim et al., 2014), bovine keratoconjunctivitis (Gard et al., 2016) and many other diseases. HOCl has even proven to be an excellent disinfectant in the fight against the latest infection of this century, the COVID-19. In our local veterinary journal (Infovet), HOCl and its use are described in individual clinical studies in wound therapy in various species of animals in a competitive preparation containing HOCl.

As a veterinarian in everyday practice, the effectiveness of hypochlorous acid in Veterinol constantly surprises me, I am still coming up with something new. Veterinol helps me keep the equipment and the areas of the ambulance clean, I apply it to the skin with every single blood draw, or by introducing i.v. cannula, before surgery in aseptic preparation of the surgical field, I apply it to wounds of various etiologies, I use it as part of therapy for conjunctivitis, especially in cats with herpes, bacterial gingivitis in dogs and calicivirosis in cats, I apply it to the throat in the case of cauldron syndrome cough in dogs, during surgery it stops mild subcutaneous bleeding, dermatitis and many others.

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