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Research Article

Effect of initial Decontamination on 1136 clinical exposures with highly corrosive chemicals

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Abstract

Purpose: Highly toxic and corrosive materials involved in eye burns are identified and the initial phase of decontamination/rinsing of severe eye burns is evaluated in context of first and secondary aid. Over a time of 30 years, one initial rinsing protocol is applied. In this longitudinal observational study we are able to compare the grade of severity related to clinically used first aid rinsing solutions like Diphoterine®/Previn®, NaCl 0,9%, Ringer's solution and Tap water.

Methods: The database used for this analysis included a total of n=1744 eyes from of n=1450 patients. Corrosives causing no higher than grade II eye burns were considered being of low corrosivity and excluded from the current analysis. Corrosives causing burns more severe than grade III eye burns were identified as highly corrosive. We identified in our database corrosives causing such accidents. We searched then in the database for any accidents with involvement of these corrosives and looked up the severity of the specific eye burns. The analysis is then specified by 1) type of corrosive, 2) type of emergency rinsing in first aid, 3) type of rinsing as secondary treatment (hospital aid), 4) grade of eye burn severity.

Results: We identified highly corrosive damage to the eye from alkali (mostly NaOH, KOH), acids (H_2SO_4, HCL, HF), calciferous (CaOH containing) and detergents (tensides from dishwashers up to special cleaners). Eyes burnt by these 4 groups of substances were n=1136 (out of 1744) eyes. For these accidents, we compared rinsing protocols and rinsing fluids. In cases of calciferous and alkali burns there was evidence that initial rinsing with Diphoterine®/Previn® appeared as best practice treatment. For calciferous burns data shows, that Previn® as initial rinsing solution lowers the grade of severity highly significant compared to water, NaCl0,9% and Ringer's solution ($p<0.0001$). Similar results are found for acid burns, while for tensides no or low significance of first aid with Diphoterine®/Previn® is shown (which probably refers to a small number of severe cases for examination in the database n= 14). In addition, the results of this analysis sharpen the assumption of concerning the initial rinsing with Diphoterine®/Previn® being for alkali significantly better than every other solution.

Conclusions: Diphoterine®/Previn® solution in first and secondary aid rinsing fluid had less severe outcomes in Roper Hall classification in treating eye burns caused by aggressive corrosive agents. This clinical results support decades of experimental research. In the light of this clinical study, a randomized prospective study seems difficult to justify.

Keywords: Aggressive chemicals; First aid; Severe eye burns; Rinsing; Water rinsing; Diphoterine rinsing; Ringer lactate; Buffers; lime; Detergents; Acid; Alkali

Introduction

Since our first evaluation of the database of eye burns [1] (Wiesner et al. 2019) we found confounding facts: first that the "no rinsing group" resulted as good or bad as the "rinsing groups". The second fact that was contrary to our experimental knowledge was that the specific decontamination with water and Diphoterine®/Previn® was similar in first rinsing.

The background of these results is that we found a regression to mean by having accidents of very low danger of severe eye burns in our database. Thus we tried to reduce the records were a severe eye burns could not be expected and any rinsing and no rinsing would result in a healthy eye. According to the severity of greater than grade II [2] burns, we found more than 40 substances that were suspicious causing only minor damage to the eye

without possibility of severe eye burns. As examples, there were substances like 70% alcohol, or saline solution with medications, Salvia, Blood and others causing little damage to the eye. To limit our datasets on severe corrosives we reviewed the database to identify only substances causing grade III and IV eye burns [1]. In this analysis we found that alkali, acid, calciferous and tensides are able to cause severe eye burns. The current analysis focusses therefore on clinical results with these substances. As in our previous investigation, we analysed the number of eyes being involved with these specific agents and we graded the severity of eye burns in context of the specific first aid rinsing and secondary, hospital based, and rinsing therapy.

Our experimental findings in animals and the EVEIT test suggest that early rinsing and efficient decontamination is result in lower grades of eye burns [2-4]. Thus, we re-evaluated our findings from [1] that secondary rinsing even in cases of eye burns with these severe corrosives is protective. We wanted to evaluate specific influences of the currently used rinsing fluids for these cases of strong corrosives.

Material

We re-analysed the data set of [1] being kept up to date for the 2nd of July 2019. In this database there were a total of n= 1744 eyes from of n= 1450 patients.

Patient records

All patients are under the personal treatment of the N. Schrage. The data collection was done retrospectively on patient records of systematic eye burns anamnesis. Data evaluation was performed according to all applicable regulations, which have changed over the past 30 years. Data were under the control of and available to only the authors. All patient identifying data were removed from the original records and identification numbers substituted for data evaluation. Data recorded in the registry included medical history, clinical emergency files, first aid treatment of all cases of corrosive chemical eye burns, eye burn circumstances, date and time of the splash injury, time of exposure, time to first aid treatment initiation, type of rinsing solution utilized, secondary aid rinsing solution utilized, clinical burn severity according to Reim's classification, and outcome.

Analysis

We performed analysis on the whole database including only corrosives which were seen in the context of grade III and IV eye burns. These corrosives we call "severe corrosives" in the following text. The 4 most dangerous types of corrosives were identified by looking on those corrosives causing injuries of the grade III and IV (Reim 1996). All III and IV grade eye burns were tracked back in the database to its causing agent. Then we identified all eyes in the database, which reported being exposed towards these corrosives. We identified a total of 1136 out of 1744 eyes being burnt by severe corrosives and classified the later analysed 4 groups by causing agents. We analysed the groups by 1) type of corrosive 2) type of rinsing in first aid and 3) type of rinsing as secondary treatment (hospital aid) and 4) grade of severity. To allow statistical analysis we condensed the resulting groups into two possible results: Group A: [2] (Reim 1996) classification (Roper Hall) grades of I and II, being known to be show "restitutio ad integrum" under therapy; and Group B: Roper Hall grades III and IV being known to be of doubtful prognosis.

We identified four types of severe corrosives with resulting grade III and IV eye burns such as..

1) Calciferous (CaOH containing), 2) Alkali (mostly NaOH, KOH and mixtures), 3) Acids (H_2SO_4, HCL, HF) and 4) Detergents (Tensides) from Dishwashers up to special cleaners (Table 1).

TYPE/GRADING	grade I+II	grade III+IV	Total
Calciferous (n= eyes)	172	164	336
Alkali (n= eyes)	151	200	351
Acid (n= eyes)	174	104	278
Tensides (n= eyes)	157	14	171

Table 1: Showing the groups and the grading of the severity of eye burns following Reim's (Roper Hall) classification.

Methods

Analysis of time when accident happens differentiated to 2006 as introduction of new treatment protocol

To check changes between the analysed groups due to a time of more than 30 years, we looked up the distribution of age, gender and type and distribution of corrosives before and after 2006 as the year of change when the hospitals and fire brigade in Cologne changed the initial rinsing protocol. At this time, we introduced for whole Cologne the first aid by rinsing with Diphoterine. We analysed the age distribution which compared with a mean of 32.6 +- 14.4 years before 2006 and a mean of 34.8 +- 16.7 years after 2006. The distribution of female to male was 21.4 % (female) to 78.6 % (male) before 2006 and 30.4% (female) to 69.6 % (male) after 2006. Statistical testing showed similar shape of distribution in age but significant difference between the age distributions furthermore chi square tests shows significant change in distribution of man and women. The later treated group (after 2006) is in mean a bit older (2.2 years) and more females are victims (+9%). Regarding these changes, we have a common german finding that workers become in mean elder and the proportion of women involved in working over this time period increased [6]. The distribution of severe corrosives before and after 2006 are given in Table 2 below.

Substance	before 2006	after 2006
Tensides	9,2	12,3
Alkali	19,5	7,8
Acid	15,4	13,2
Calciferous	17,4	11,70
Other corrosives	38,5	55,0

Table 2: Percentage of distribution of severe corrosives before and after 2006.

Incidence of eye burns pre and after 2006

The incidence of severe corrosives over the last years was 14.6 cases per year before 2006 and 14,3 cases per year after 2006. There is a constant exposure with severe corrosives but a slight difference in the age and sex of the victims. There is a slight change with an increase of tensides and a consecutive decrease of alkali, calciferous and acids during the last 30 years. There is a slight diminution in the proportion of severe cases, but the absolute number of severe cases remained the same per year Table 2.

Target of analysis

By this analysis of severe corrosives we want to know whether the result of [1] (Wiesner et al. 2019) "that water and Diphoterine®/Previn® performed similar in initial therapy" can be confirmed or rejected in this most important severe type of eye burns.

We performed statistical analysis comparing contingency 4x4 tables of each group (corrosives and type of rinsing) compared to the others for each group of corrosives. Unless the numbers of treated patients sometimes are small, Fisher's exact test determines differences in the outcome. The analysis was done using Prism®7e Graph Pad software version.

Data handling

"Unknown rinsing solution group"

Special considerations undertaken to evaluate the effects of primary and secondary help. Due to "unknown rinsing solution" in first or secondary help, we classified this group separately and omitted data when looking on the global outcome of all rinsing efforts including primary and secondary rinsing.

"no rinsing" group

This group includes 191 eyes. Out of these, 91 were rinsed with water at the site of the accident and had no further rinsing at the hospital. All these 91 showed grade I-II burns; no severe eye burns were seen. 66 eyes did not receive any rinsing at the site of accident neither at the hospital. No eye had a severe eye burn and this group divided to grade I (n= 49)-II (n=17). We assume that there was for patients and doctors a high clinical evidence that these eye burns were so minor, that the first aid treating emergency team or ophthalmologists decided not to perform any rinsing. Interestingly there were 47 eyes with no initial rinsing which were then rinsed in the hospital with Diphoterine®/Previn® out of these there were n=32 grade I, 5 grade II, 9 grade III and 1 grade IV eye burn. This reflects that despite of a "non-treatment" decision in emergency the ophthalmological doctors in the hospital found evidence of severe eye burns and in consequence treated according to the protocol.

We handled these data as following: We included the "initial water rinsed" and the no rinsing eyes in the "water" group and analysed their outcome.

We omitted the "not rinsed" eyes from our analysis because there is evidence that the trauma was not severe. The "primary no rinse / secondary Previn® rinse" group is introduced in the "any Previn®" group in regarding the clinical outcome. We condensed all data with involvement of Previn®, Water, NaCl 0.9% and Ringers-lactate in considering all groups of severe corrosives including "calciferous, alkalis, acids and tensides". We excluded from this analysis patients being treated with "unknown rinsing fluid" and any patients with "no rinsing". These two groups are so inhomogeneous concerning severity of agent and the clinical symptoms that statistics are not applicable.

The groups of rinsing fluids were analysed. We introduced two special cases of rinsing which we analysed separately: those who received an initial rinsing with tap water and a secondary rinsing with tap water and another group receiving "any type" of initial rinsing (without Diphoterine®/Previn®) and a secondary rinsing with Diphoterine®/Previn®. We named this group: "any/ Diphoterine®/Previn®".

Results

We analysed thus 4 groups of severe corrosives and 7 groups of rinsing fluids. These are presented and splitted in Table 3 indicating the number of eyes being burnt, the groups of corrosives and the types of rinsing (Table 3). According to Wiesner et al. [1] we classified the rinsing at first aid with groups of no rinsing, Unknown rinsing fluid, Ringer's, 0.9% NaCl solution water and Diphoterine®/Previn® solutions. We found that cases being affected by severe corrosives built a majority in our database n=1136 out of n=1744 burnt eyes.

Group of corrosives	Calciferous		Alkali		Acid		Tensides	
Rinsing type/severity of burns n=eyes	I+II	III+IV	I+II	III+IV	I+II	III+IV	I+II	III+IV
NaCl first	4	9	4	13	12	1	9	0
Previn first	6	0	7	3	4	1	13	1
Ringer first	0	14	2	13	4	13	2	1
„unknown“ first	14	45	19	70	15	28	0	2
water first	43	88	60	76	61	47	73	10
any/ Previn	88	8	50	25	59	14	39	0
water / water	1	12	6	6	5	5	1	3
total	172	164	151	200	174	104	157	14

Table 3: Data set being analysed by statistical analysis in multiple 4x4 contingency analysis. Each group tested against others concerning the efficacy within the burning classes. See tables 4-7.

The group of corrosives, the severity in grading outcomes and the treatment are referred in Table 2. The resulting contingency 4x4 comparison tables are given in Table 4-7.

Calciferous							
Significances	**NaCl first**	**Previn first**	**Ringer first**	**„unknown“ first**	**water first**	**any/ Previn**	**water/ water**
NaCl first	ns	p=0.0108	p=0.0407 (ringer worse)	ns	ns	p<0.0001	ns
Previn first		ns	p<0.0001	P<0.005	p=0.0017	ns	p=0.0003
Ringer first			ns	ns	p=0.0106	p<0.0001	ns
„unknown“ first				ns	ns	p<0.0001	ns
water first					ns	p<0.0001	ns
any/ Previn						ns	p<0.0001
Water/Water							ns

Table 4: Data column 1 and 2 of Tab. 2 analyzed by 4x4 contingency analysis Fisher’s exact test. The data shows that Previn first and any/Previn lower the grade of eye burns severity in calciferous agents highly significant compared to the rinsing groups of water first, water/water, saline solution and Ringers solution. Beyond this there is interesting that water first rinsing is superior to rinsing with Ringer solution. In this context we note that rinsing with saline solution results in slightly better results than Ringers solution. (ns: no significant difference, p = error probability).

Alkali							
Significances	**NaCl first**	**Previn first**	**Ringer first**	**„unknown“ first**	**water first**	**any/ Previn**	**water/water**
NaCl first	ns	p=0.0402	ns	ns	ns	p=0.002	ns
Previn first		ns	p=0.009	p=0.0029	ns	ns	ns
Ringer first			ns	ns	p=0.026	p=0.0003	ns
„unknown“ first				ns	p=0.0006 water much better	p=<0.0001	ns
water first					ns	p=0.0024	ns
any/ Previn						ns	ns
water/water							ns

Table 5: Data column 3 and 4 of Tab. 2 analyzed by 4x4 contingency analysis Fisher's exact test on Alkali. The data shows that there is overall better performance of Previn first on rinsing with Saline solution, Ringer's solution and „unknown“ solutions. The comparison to water/water versus Previn and any/Previn shows statistical difference in outcome. The overall use of Previn at any time shows significant improvement. Water is superior to Ringers initial use and to „unknown“ solutions. (ns: no significant difference, p = error probability).

Acid							
Significances	**NaCl first**	**Previn first**	**Ringer first**	**„unknown“ first**	**water first**	**any/ Previn**	**water/ water**
NaCl first	ns	ns	p=0.0002 / NaCl better	p=0.0003	p=0.0147	ns	ns
					(NaCl better)		
Previn first		ns	p=0.0393	ns	ns	ns	ns
Ringer first			ns	ns	p=0.0172	p<0.0001	p=0.0183
					(water better)		
„unknown“ first				ns	p=0.0195 (water better)	p<0.0001	p=0.0349 water better)
water first					ns	p<0.0007	ns
any/ Previn						ns	ns
water/water							ns

Table 6: Data column 5 and 6 of Tab. 2 analyzed by 4x4 contingency analysis Fisher's exact test on acids. The data shows that there is slight better performance of "Previn first" to Ringers solution but not on saline solution. Saline rinsing performs better than „unknown's" and water first. Water rinsing performs better than Ringers and „unknown“ solutions. Any Previn is significant better than water, ringer and „unknown“ solutions first. (ns: no significant difference, p = error probability).

By this analysis, we identify for calciferous burns and for alkali, there is high evidence that best practice treatment is an initial rinsing with Diphoterine®/Previn® (Table 4).

Regarding Alkali burns (Table 5) there is evidence that water and Diphoterine®/Previn® perform better than all other rinsing solutions. The delayed rinsing (in hospital) with Diphoterine®/Previn® proves significant better grading outcomes compared to any other rinsing solution. Identifying the origin of this result we find a high number of water first n=60 grade I+II and n=76 grade III+IV and for Diphoterine®/Previn® first n= 7 grade I+II and n= 3 grade III+IV (Table 3 columns 4/5). This confirms one of the results of (Wiesner et al. 2019) on different rinsing solution being used in first and secondary aid.

Looking on acids Table 6 the image becomes less clear. The water rinsing has significantly less severe eye burns than the rinsing with saline, Ringer or unknown. The Diphoterine®/Previn® rinsing showed less severe eye burns than Ringers rinsing. The any/Previn group has less severe eye burns compared to Ringer or Unknown first aid rinsing. This result is driven by a low number of initial rinsing's with Previn (n=4 grade I+II) and n=1 (grade III+IV) and a high number in the group of any/Previn n= 59 grade I+II and n= 14 grade III and IV (Table 3 column 6/7 lines 4/8).

The results for water being used on decontamination of detergents (Tensides) are weaker but there is a tendency to better results with Diphoterine®/Previn®. The small number of patients in this group weakens this finding. (Table 7).

Tensides							
Significances	**NaCl first**	**Previn first**	**Ringer first**	**„unknown" first**	**water first**	**any/ Previn**	**water/ water**
NaCl first	ns	ns	ns	p=0.0182	ns	ns	P=0.014 (water worse)
Previn first		ns	ns	p=0.0205	ns	ns	p=0.0186
Ringer first			ns	Ns	ns	ns	Ns
„unknown" first				ns	p=0.0185 (water better)	p=0.0012	Ns
water first					ns	p=0.029	p=0.0098
							Water first better
any/ Previn						ns	p=0.0003
water/water							ns

Table 7: Data column 7 and 8 of Tab. 2 analysed by 4x4 contingency analysis Fisher's exact test on tensides (detergents). The data shows that there is overall no or low significancy in comparing performance of different rinsing solutions onto tensides. This is explainable by the small number of severe cases with 14 out of 171 patients and mainly by the common action of dilution of any of the watery rinsing solutions on detergents. This is similar in all agents. The statistical indicators show a little tendency towards the use of water and Previn. (ns: no significant difference, p = error probability).

Discussion

Criticism of the anamnestic and demographic data in this study

The patient's anamnestic survey of our database concerning type and length of initial eye burns and rinsing suffers a known weakness. The emotionally affecting situation like eye burn accidents changes perception and memory. There is a patient tendency to fill missing memory gaps to tell a whole story [7]. Concerning the rinsing there are a lot of data in our database relying on first aid helpers reports and on the victim memory.

Another weakness of the study is the uncertainty of the time duration of rinsing if patient reported. Professionals performing the rinsing in our experience of observation tend to report slightly longer rinsing times as really performed.

The difference of age in our two groups before 2006 and after 2006 is due to the aging structure of German population during the last 30 years with a mean change of more than 3 years [6] (www.bib.bund.de/DE/FAKTEN/FAKT/B19). The more women involved in accidents after 2006 is related to the higher participation of women in professional work during the last 30 years starting with a women participation of 57 % on work in 1991 to currently 71.5% in 2017 [8]. The change of severe corrosives with a tendency of less alkali and calciferous eye burns might be

related to improved safety measures especially in these two most dangerous corrosives. Any data on this shift of corrosives involved in eye burns not been found and are object of assumptions.

Discussion of the Corrosive decontamination results

Patients without rinsing therapy

Patients who received no initial and no further rinsing were put into the group of "no rinsing". This group showed in contrast to an expected bad result, clinical outcomes of very low grades (n=30 grade I+II, n= 0 grade III and IV). Knowing that possibly, patients themselves felt that nothing "severe" happened we assume that this group had a very light contact with corrosives which had not induced any damage. This is in contrast to clinical and experimental knowledge of the disaster action of severe corrosives in case of missing first aid rinsing [3]. Due to this striking gap of reported severe corrosive and missing clinical symptoms, we did not continue to analyse this group. For this group we have the assumption, that these people did not feel much problems after a supposed contact, but knew about the consequences of the type of corrosive and contacted an ophthalmologist. As the specialists did not find any severe eye burns, there were no indications to rinse. By that, we excluded these patients from the presented data.

Patients with severe corrosive burn and qualified rinsing therapy:

We found efficacy for first aid rinsing with water and the water /no rinsing group with 91 grade I/II eye burns. No severe burns were analysed in the "water first" group and introduced in the overall analysis of all solutions. The "not rinsed" and later treated by Diphoterine®/Previn® eyes were analysed in the "any Previn®" group showing a favourable outcome. Patients with "unknown rinsing therapy" were excluded in the secondary analysis of overall action of the rinsing therapies due to uncertainty of the action of this treatment regime.

Patients with corrosives and qualified first and secondary rinsing:

There is a confirmation of the experimental work from the past that in the clinical rinsing therapy there is a difference between water-, iso-osmolar- and hyper-osmolar decontamination rinsing. Different approaches of eye rinsing with hypo-osmolar solutions dilute corrosive agents effectively, but lead to typical secondary effects like chemosis and immediate corneal opacification as described by [2] (Reim 1989) and Roper Hall in their classifications. If iso-osmolar solutions are used, an osmolar difference still exists but not high enough to initiate a physical cleavage by fluid and electrolyte outflow from the affected tissue. As a result, these rinsing media clean the surface but immerse into the tissue and tend to increase the damage.

Another way of decontamination is the hyperosmolar rinsing (Diphoterine®/Previn®). By osmotic forces, there is an efficient physical removal of water and electrolytes from the corneal stroma. The amphoteric reaction on the surface removes (decontaminates) the corrosive components.

Isoosmolar buffers showed no impact on the pH whereas highly concentrated buffers with hyperosmolar fluid composition in experimental studies reduced the pH in the eye efficiently [5] giving proof of the hyperosmolar and decontamination concept. In addition, when promptly applied, this treatment causes dehydrated mucosal tissue of the trachea to rehydrate [9].

As universal treatment option on severe corrosives Diphoterine®/Previn® has in this study being proven to be the most favourable first aid rinsing solution treating eye burns caused by polyvalent agents (Figure 1, Tables 4-8). This clinical evaluation supports experimental research of the last 2 decades of our group. These results classify with experimental data from the past [1,3,5,10].

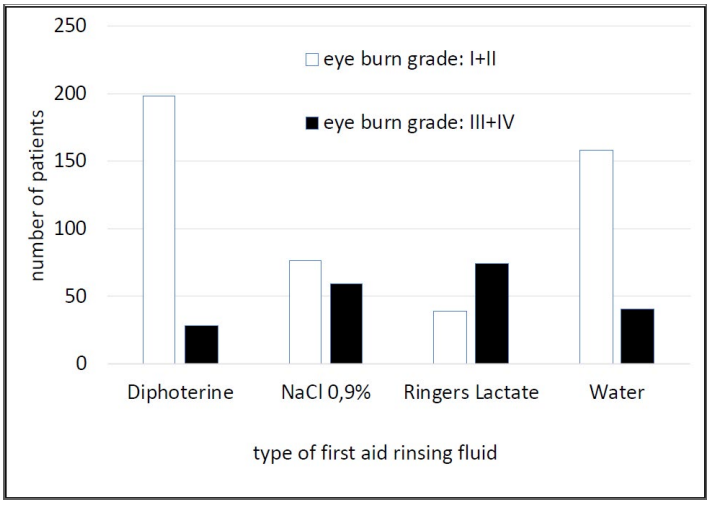

Figure 1: Decontamination of severe corrosives by first aid rinsing solutions. The grade III and IV group are proportional lower for Previn followed by water saline and ringers lactate. There is a significant shift from severe burns to healing burns if the appropriate rinsing solution is taken in first aid.

The differentiation on 4 groups of corrosives and the different action on those corrosives is most interesting. The alkalis and calciferous are known from our experimental work to be the most dangerous substances. New in this study is the good action of either water or Diphoterine®/Previn® on acids. The rinsing of detergents with any watery solution seems to be a good idea. The damaging action of detergents are not related to pH and osmotic forces thus therapy of eye burns with this type of corrosive is best with any watery solution.

Even we had low absolute numbers of initial rinsing with Previn/Diphoterine the data set is sufficient to give prove for alkali that it is preferable to rinse with this solution. Lot of detergents are related to alkali or acid in cleaning purposes. Thus Table 8, gives a clear advice for any type of eye burns to rinse with the Previn®/

Diphoterine® in any case of Unknown corrosive. For most of all corrosives, this will be the best treatment. For any first aid, helper it is difficult to decide which type of corrosive is involved. The delay to find this out and then initiate appropriate rinsing [11] is unacceptable knowing the experimental results of [3-5].

Type of any rinsing/ grade of burn	I+II	III+IV	Previn	Water	NaCl	Ringer
Previn	198	29	ns	0.0358	<0.0001	<0.0001
water	158	41		ns	<0.0001	<0.0001
NaCl	77	59			ns	0.0006
Ringer	39	75				ns

Table 8: Dataset being analysed concerning all groups and their outcome concerning involved rinsing substances. There is evidence that Diphoterine®/Previn® performs significantly better than water and highly significantly better than NaCl and Ringer solution concerning the final grade of eye burns. The next best solution is water, which shows clinically better results than NaCl and Ringer's solution. Driver of this overall result are the alkaline like "alkali" and "calciferous" groups (Table 5).

Future aspects: To safeguard the efficacy of rinsing fluids in first aid there is in terms of narrow-minded "evidence based medicine" the necessity of a prospective double blind clinical study on eye burns. This has been argued and demanded by different authors [12,13]. This study should compare after the data presented by Wiesner [1] initial water rinsing with initial Diphoterine®/Previn® decontamination. A second decontamination in the hospital might be done with Diphoterine®/Previn ® based on the current and former study of [1].

Following our results from this study we find highly significant changes in prognosis of consecutive cases being subjected to 2 different treatments during the time of 30 years to be of good evidence to be considered as valid. We are convinced that the standard approach of randomized prospective double blind study being introduced in medical research as standard method to find out differences comparing therapies with small differences and of unknown causalities will fail as confirmed by Rödiger in a methodological approach [14]. In contrast to unknown differences of rinsing agents but clear evidence that early rinsing is improving the prognosis [15], in our scientific work we have known and proven differences of specific action onto the considered substances. The analysis of this difference of exactly the same type of accidents with distinct differences in treatment is able to give high evidence on the necessity of changes in first aid for eye burns, which is still not confirmed in the new German guideline for this topic [16]. Following the results of our experimental and clinical analysis, we are convinced that a randomized prospective double-blind study comparing first aid water decontamination against Diphoterine® is an inappropriate method, which would bring patients in danger and thereby will be unethical und unnecessary.

References

1. Wiesner N, Dutescu RM, Uthoff D, Kottek A, Reim M, et al. (2019) First aid therapy for corrosive chemical eye burns: results of a 30-year longitudinal study with two different decontamination concepts. Graefes Arch Clin Exp Ophthalmol 257: 1795-1803.
2. Reim M (1989) Ein neues Behandlungskonzept für schwerste chemische Verbrennungen und Verätzungen des Auges. Fortschr Ophthalmol.
3. Rihawi S, Frentz M, Becker J, Reim M, Schrage NF (2007) The consequences of delayed intervention when treating chemical eye burns. Graefes Arch Clin Exp Ophthalmol 245: 1507-13.
4. Rihawi S, Frentz M, Reim M, Schrage NF (2008) Rinsing with isotonic saline solution for eye burns should be avoided. Burns 34: 1027-32.
5. Rihawi S, Frentz M, Schrage NF (2006) Emergency treatment of eye burns: which rinsing solution should we choose? Graefes Arch Clin Exp Ophthalmol 244: 845-54.
6. Durchschnittsalter der Bevölkerung in Deutschland (1871-2018).
7. Strange D, Takarangi MK (2012) False memories for missing aspects of traumatic events. Acta Psychol (Amst) 141: 322-6.
8. Hobler D, Pfahl S, Spitznagel J (2019) Wirtschafts- und Sozialwissenschaftliches Institut der Hans Böckler Stiftung.
9. Goralski JL, Boucher RC, Button B (2010) Osmolytes and ion transport modulators: new strategies for airway surface rehydration. Curr Opin Pharmacol.
10. Alexander KS, Wasiak J, Cleland H (2018) Chemical burns: Diphoterine untangled. Burns 44: 1012-1013.
11. Claassen K, Rodil Dos Anjos D, Broding HC (2021) Current status of emergency treatment of chemical eye burns in workplaces. Int J Ophthalmol 14: 306-309.
12. Mohammad Soleimani, Morteza Naderan (2020) Management Strategies of Ocular Chemical Burns: Current Perspectives. Clin Ophthalmol.
13. K Skaria Alexander, Jason Wasiak, Heather Cleland (2018) Chemical burns: Diphoterine untangled. Burns 44: 752-766.
14. Rödiger T. Müller A.C. Graalmann J, Schlomm T (2019) Genauere Evidenz für Präzisionsmedizin notwendig. Deutsches Ärzteblatt 116: 1708-12
15. Chau JP, Lee DT, Lo SH (2010) Eye irrigation for patients with ocular chemical burns: a systematic review. JBI Libr Syst Rev 8: 470-519.
16. Akute chemische Verätzungen des Auges: S1 Leitlinie der Deutschen Ophthalmologischen Gesellschaft (DOG) und des Berufsverbandes der Deutschen Augenärzte (BVA)]. Ophthalmologe. 2021 Mar 5. doi: 10.1007/s00347-021-01326-3. Online ahead of print. PMID: 33666702 Review.