Chemical Burns
First-aid Regarding Hundred Exposures

Dr Parag Kulkarni

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Chemical /thermal burns
Is there any difference?

Compare a chicken roasted in an oven

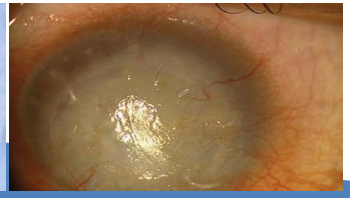
with a chicken immerged in a strong basic solution

Can you see any difference?

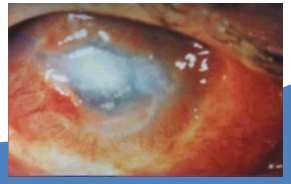
Why use water after a chemical splash?

Advantages	Limitations
Washing effect	Passive rinsing NO absorption, NO neutralisation
Dilution effect	Rinses ONLY on the surface What about penetrated chemical?
Polyvalence	Not sterile

Water does NOT stop the chemical reaction



- HOSPITALISATION, BLINDNESS
- WORK-LOSS



Diphoterine® Improved version of water

Advantages	
Aqueous solution maintaining the fundamental properties of water	Pulls chemical aggressor away from the surface of tissues
Amphoteric solution	Acts on acids as well as bases and rapidly restores eye and/or skin's physiological pH
Hypertonic solution	Stops penetration of corrosive chemicals into tissues creating a flux from inside to outside
Limitations	
Cannot be used on white phosphorus exposures and limited efficacy on hydrofluoric acid	

Diphoterine®
Innocuousness and Properties

- non irritating to eyes or skin (pH = 7.4)
- rinsing residues (for acids and bases)
- good immediate relief from pain
- non toxic (acute oral dermal LD_{50} > 2000 mg/kg)
- non cytotoxic (keratinocytes fibroblasts)
- non mutagenic (Ames test)
- non sensitizing
- no side effects reported on usage

Study at Boisar Tarapur Industrial Area by Surgeon Dr Kulkarni 28 years of experience over 5000 chemical burns

Data

- During 10 months of this study 110 cases industrial chemical burns were registered

Methods

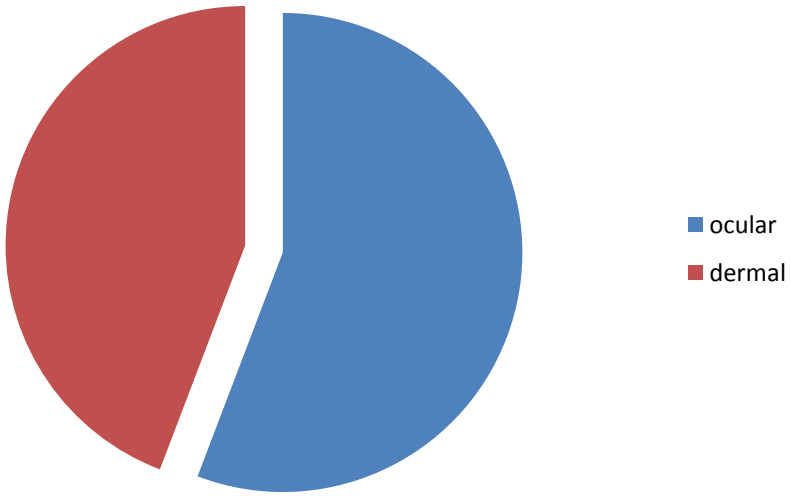
- Water used as first rinsing within first 10mn after exposure on site
- Diphoterine® solution used within 20mn after exposure upon arrival at clinic off site
- When both solution were used - water used within 10mn after exposure - Diphoterine® solution after 30mn

Study Boisar Tarapur Industrial area

- Clinic being situated 10mn away from industrial area in 31 cases patients came to clinic without first rinsing with water on site

- 71 cases rinsed with water only on site
- 31 cases rinsed with Diphoterine® solution only off site
- 8 cases with water first and Diphoterine® solution off site upon arrival at clinic

Distribution of splashes



- ocular = 55%
- dermal = 45%

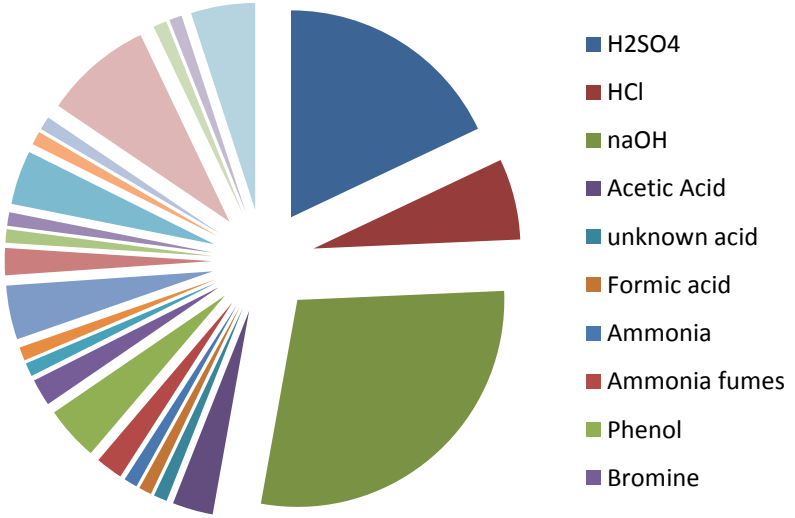
110 cases in total

Distribution of splashes according to industries

Industry	glass	chem	dyeing	pharma	steel	food	Total
%	2%	46%	26%	22%	1%	2%	100%

H_2SO_4	18
HCl	6
NaOH	28
Acetic Acid	3
unknown acid	1
Formic acid	1
Ammonia	1
Ammonia fumes	2
Phenol	4
Bromine	2
Bromine fumes	1
Di Ethyl Sulfate	1
DMS	4
DMS fumes	2
Glycol	1
Phosphorus	1
MDC & MDC mix	4
MB Ketone	1
Toluene	1
	8

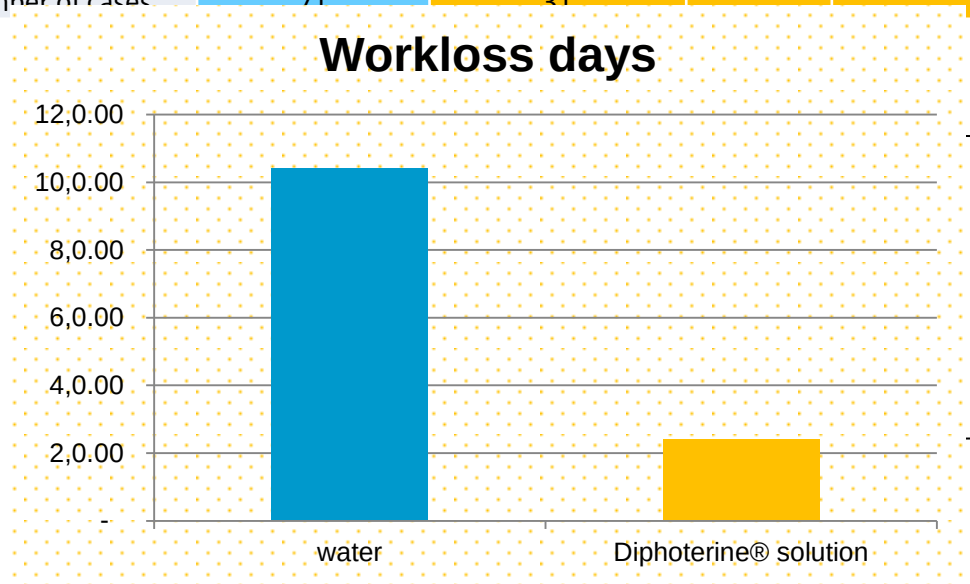
Distribution of splashes according to chemicals



Work loss after splashes in the study

	water	Diphoterine® solution	*p*	*Difference*
gap from exposure till rinsing (mn)	9,43	19,33	<0,01	**significantly longer delay**
standard deviation ±	0,593	1,73		
mean age (years) of patient	34,58	32,00		**No difference**
standard deviation ±	9,65	10,19		
cases	**71**	**31**		
all	water	Diphoterine® solution		
days of workloss	**10,41**	**2,41**	<0,01	**Significantly fewer days of workloss**
standard deviation ±	18,12	2,27		
number of cases	71	31		

Exclusive rinsing
Either
Diphoterine® solution
OR water
Not both



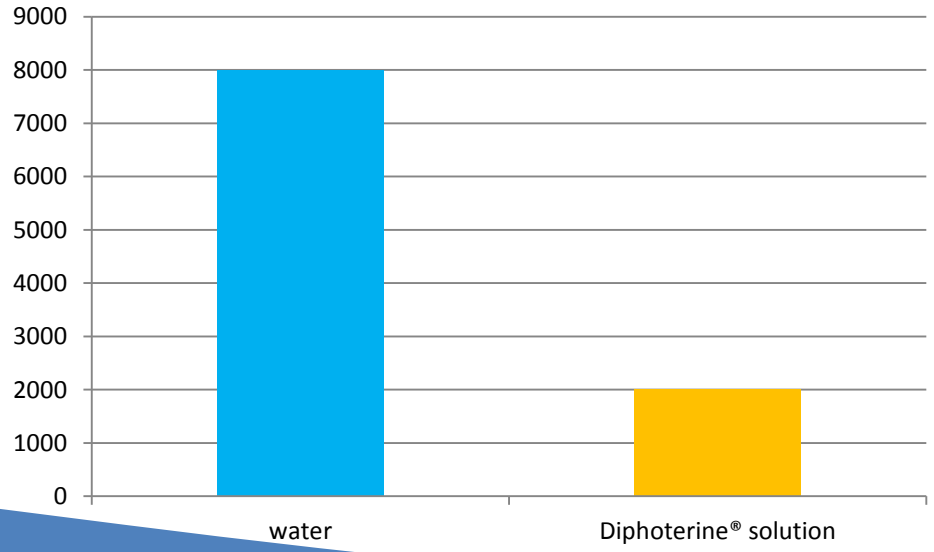
Number of work-loss days with Diphoterine® solution not even 1/4 of the ones with water

Results: COST of HOSPITALIZATION

after splashes

all cases (ocular, dermal), all chemicals

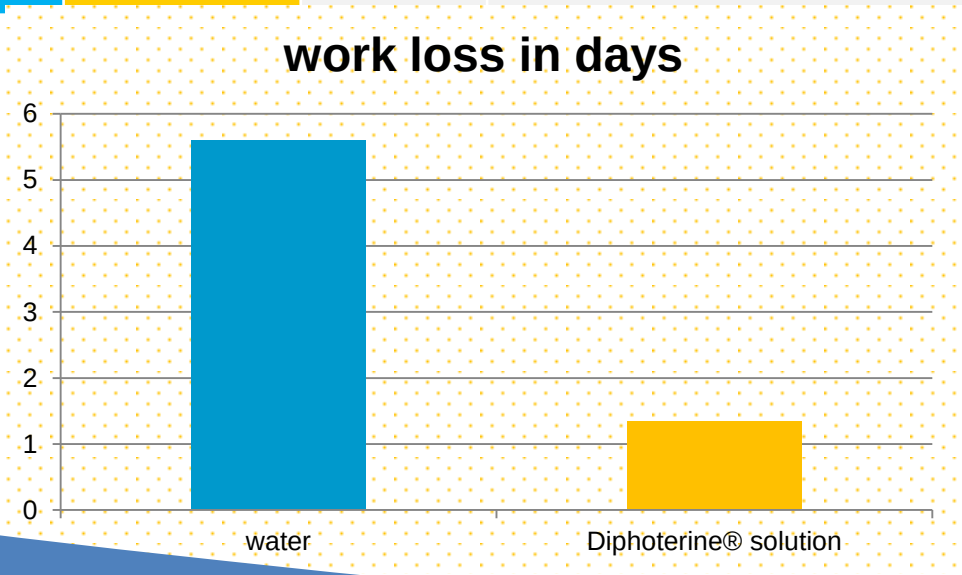
all	water	Diphoterine® solution	*p*	Difference
Average cost of hospitalization post accident	**8085**	**2065**	**< 0.01**	**Average cost of hospitalization with Diphoterine® solution significantly less important than with water**
standard deviation ±	12449	2108		
number of cases	**71**	**31**		



the cost of hospitalization with Diphoterine® solution is 1/4th of the one with water

Results: work loss after splash in eyes (days)

ocular splashes	water	Diphoterine® solution	*p*	Difference
work loss in days	**5,6**	**1,35**	**< 0,001**	**Victims decontaminated with Diphoterine® solution have a number of workloss days significantly different from those washed with water.**
standard deviation ±	5,81	1,61		
number of cases	25	32		



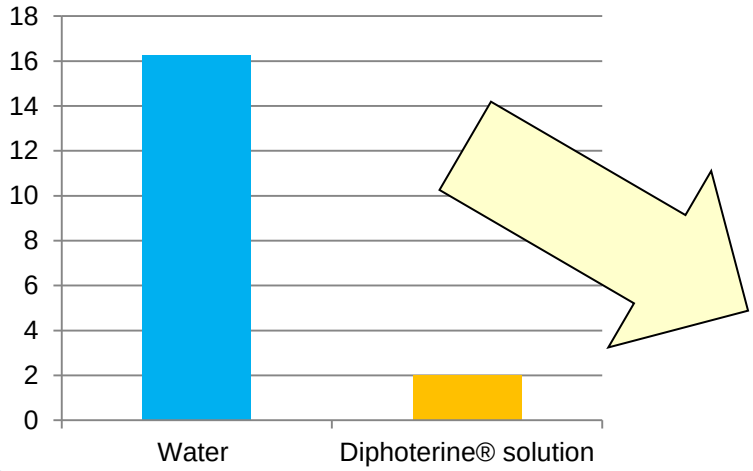
the number of days to work-loss with Diphoterine® solution is not less than 1/3 of the one with water

Work-loss after DMS Splashes

Exclusive rinsing
Either
Diphoterine®
solution
OR water
Not both

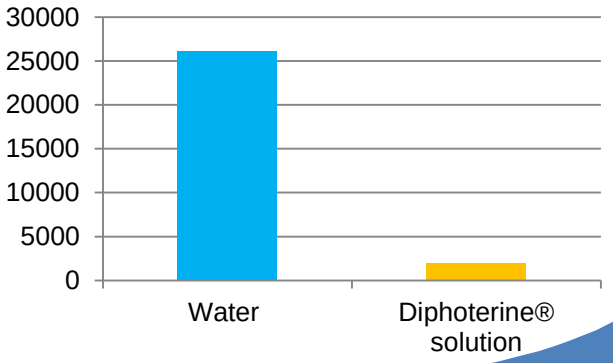
Di Methyl Sulfate DMS ocular splash	water	Diphoterine® solution
cases (number of eyes splashed)	7	2
work loss in days	**16**	**2**
standard deviation	8	-
medical complication after rinsing	corneal ulceration in 4 cases	none

work loss in days



Number of work-loss days with Diphoterine® solution is 1/8 of the ones with water

Average cost of hospitalistion in INR post rinsing



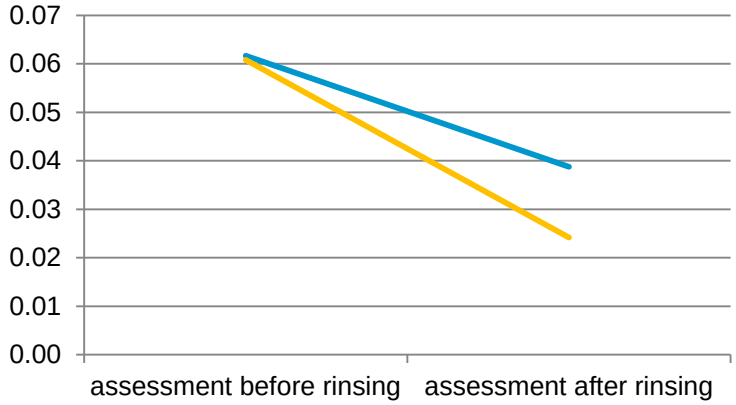
Results of pain factor (second part of the study: from december 2015 onwards over 38 cases)

all cases (ocular, dermal), all chemicals

	water	Diphoterine® solution	*p*	Difference
gap from exposure till rinsing (mn)	9,81	18,75		
standard deviation	0,981	2,261		
mean age (years) of patient	34,31	33,17		
standard deviation	9,09	9,11		
cases	**26**	**12**		
assessment of pain before/after rinsing				
average pain improvement (scale 1 to 10)	**2,12**	**3,67**	*< 0,001*	
standard deviation	0,86	0,65		

The pain is assessed by the patient before and after the rinsing at the clinic

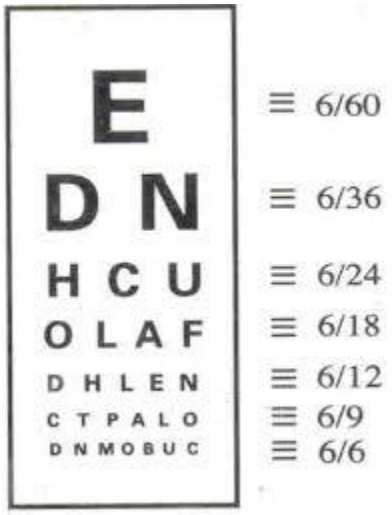
Victims decontaminated with Diphoterine® solution present a before/after pain change significantly different from those washed with water.



Solution	Average decrease of pain	Average pain goes from
Water	2,12	**6,1 to 3,8**
Diphoterine® solution	3,67	**6 to 2,4**

Results of Visual Acuity (second part of study: from Dec onwards over 28 cases) Ocular splashes, all chemicals

Visual acuity before VS after rinsing with	Water	Diphoterine® solution
Improvement of 1 acuity level **e.g. 6/9 to 6/6**	3/16	8/12
Improvement of 2 acuity level **e.g. 6/12 to 6/6**	0/16	2/12
Total cases	**16**	**12**



The visual acuity is measured before and after the rinsing at the clinic (Snellen's 6/6, 6/9, 6/12, 6/18 etc.)

Average chances of improvement:

With water:	19%
With Diphoterine® solution:	84%

28 cases with NaOH, DMS, Methanol, Acetic acid, H_2SO_4

15 MINUTES AFTER ACETIC ACID splash

INJURY TO EYE

- Left eye
- ***500ml Diphoterine® solution*** applied after 15mn
- 500ml

45 MINUTES AFTER using ***Diphoterine® solution***

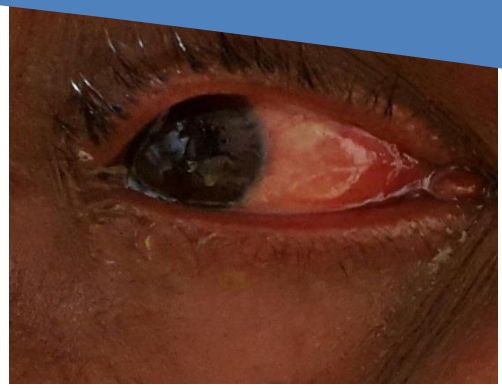
Conjunctival oedema has decreased, Lid oedema has also decreased, Less epiphora after this

12 HOURS AFTER ***Diphoterine® solution*** WASH: Cornea and conjunctiva clear

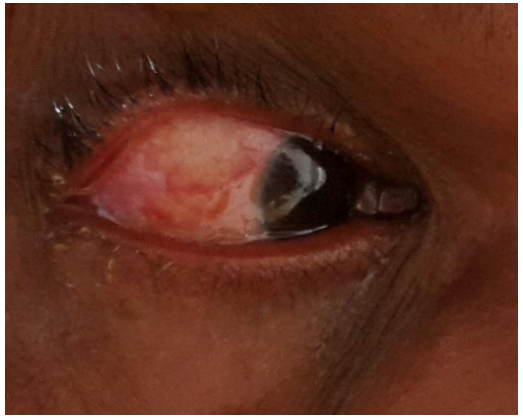
No surronding oedema

DILUTE SULFURIC ACID (2%) IN EYE

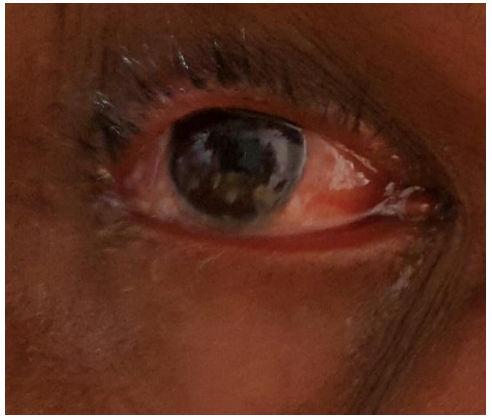
A: On arrival



B:20mn after splash: use of ***Diphoterine® solution***



D:FOUR HOURS STATUS
- Conjunctival oedema reduced
- congestion, epiphora less
- improvement in visual acuity



C:1 hour after

Phenol use at Tarapur, India
Initial clinical conditions
2016, March 9th at 11:15 am

2016, June 18th

Conclusion

During study no patient has shown any side-effects after using Diphoterine® solution

Work loss days are reduced

Subjectively and objectively Diphoterine rinsing has the advantage over conventional water rinsing

Cost effective for employers as well as employees

Dr Kulkarni receiving the **award** for best poster at the Nordic Burns Association of Plastic Surgeons **July 2016 SWEDEN**

THANK YOU for your attention