Queensland Injury Surveillance Unit

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QISU collects and analyses data from emergency department injury presentations on behalf of Queensland Health. Participating hospitals represent three distinct areas of Queensland.

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Eye Injuries in the Coal Mining Industry

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Summary

- Amongst workers in the coal mining industry eye injuries are the second most frequent body site injured after hand injuries (20% vs 31%).
- Eye injuries are most frequently associated with dust (37%), grinding (29%) and welding (18%).
- Boiler makers and other trade workers were most frequently injured, with mine workers making up less than half of those with eye injuries.
- The incidence of eye injuries in the Queensland coal industry is similar to that reported elsewhere and in previous generations.
- Prevention of eye injuries in the coal industry and other workplaces is dependent on universal usage of appropriate protective eyewear. This requires an appropriate design acceptable to the majority of workers, an on-going worker education plan, periodic monitoring and active enforcement.

Introduction

Eye injuries in industry have always been a particular concern due to the risk of visual impairment. Coal miners are vulnerable to eye injuries because of a number of factors in the workplace:

- The collision of hard metal with coal and rock in coal extraction and exploration or tunnelling.
- The use of stone dust in roadways to prevent ignition of air borne coal dust.
- Active ventilation of the mine workings.

Serious eye injuries can be caused by metal and rock fragments created from the use of tools in underground and surface operations. High velocity particles are produced where there is hammering of metal on metal, and these can penetrate the unprotected eye of an operator or bystander.

Chemicals used in the mining industry may also cause eye irritation, as may ultraviolet radiation from welding. Injury may also occur due to the escape of air, water or lubricants under high pressure from the misuse or rupture of high-pressure lines.

Coal mines are dusty places. Underground dust particles largely originate from coal, rock, and metal fragments from the use of large pieces of machinery. Dust is also widespread on

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the surface at the prep plant, where the coal is washed and separated, at the stockpile, where it is stored and where there is a lot of movement of plant and heavy machinery.

Protective eyewear has the potential to reduce the risk of eye injury but several barriers to their use have been noted. These include visibility, cleanliness, comfort, appearance and conditions of storage of eyewear near the work area. By law, eye protection must be worn on coal mining sites at all times.

Method

This study examines data collected for the Queensland Injury Surveillance Unit from participating hospital Emergency Departments, during the 3 year period 1998 to 2000. Emergency Department presentations for injury related to coal mining for the Mackay and Moranbah Health Districts were examined. This covered a total population of 20,184 in the Moranbah Health District and 108,805 in the Mackay Health District. The main occupations in this area are grazing, farming and coal mining. As of 30 June 2001 3,800 persons were directly employed in the coal mining industry in this area[1]

The injured workers presented to the Emergency Department of their respective hospitals, where a detailed description of the circumstances surrounding the injury was taken. The data presented in this analysis does not include details regarding whether eye protection was worn or not or whether the eye injury was caused by the workers own work or by another worker in their vicinity. It has been reported elsewhere that approximately 20% of eye injuries occur amongst bystanders[2].

Results

There were 411 coal mining industry related injury Emergency Department presentations in Moranbah and Mackay Districts identified during the study period. Analysis of these data showed that hand injuries were the most frequent body site injured (129 injuries, 30.9%) followed by eye injuries (83, 19.6%), multiple body sites (28, 6.7%), head injuries, excluding the face, (21, 5%) and knee injuries (19, 4.5%).

The proportion of eye injuries in the coal industry workers is similar to the proportion of eye injuries for all workers in Queensland (21%) but less than that seen in the construction industry (31%). The rate of eye injuries in the coal mining industry presenting to hospital EDs in this study is 7.3 per 1000 employees per annum. Ten of 83 injuries were an urgent threat to vision. But the majority had a triage category of semi-urgent or non-urgent indicating that most eye injuries are minor in nature.

Frequency and pattern of eye injury

On reviewing the mechanism of mining eye injuries, dust is commonly involved (Table 1). The nature and source of the dust was not always defined. Grinding and welding also contribute significantly to eye injuries accounting for 28.9% and 18.2% of eye injuries respectively (Table 1). On the mine surface there will be metal particles in the workshop bays. Most of the repair work is done on the surface due to the dangers of a fire hazard underground from spontaneous combustion. Rupture of high pressure hosing is also a significant mechanism of eye injury (7.2%). This occurs on the surface and underground.

Incident Causing Eye Injury	*Number*	*Percentage*
Welding	15	18.2
Grinding	24	28.9
Cutting	1	1.2
Splash	1	1.2
Dust	31	37.3
Chemicals	4	4.8
Ruptured piping	6	7.2
Hit by a drill	1	1.2
Total	**83**	**100**

Table 1: Frequency and mechanisms of Emergency Department presentations related to eye injury in the coal industry, QISU ED presentations 1998-2000.

Principal Occupation of Worker	*Number*	*Percentage*
Boiler maker	21	25
Mine worker	19	22.6
Fitter	15	17.9
Apprentice Miner	1	1.2
Electrician	3	3.6
Plant Operator	11	13
Spray Painter	1	1.2
Trade Misc	10	11.9
Welder	2	2.4
Total	**83**	**100**

Table 2: Occupation of eye-injured workers in the coal industry, QISU ED presentations 1998-2000

Occupation of injured workers

On reviewing the cases presenting with eye injuries the largest group are boilermakers (26.2%) followed by mine workers (22.6%). Multi-skilling is common at mine sites, consequently there will be some overlap of exposure rates of the different groups. It was not possible to determine whether these injuries occurred above or below ground.

Discussion

Most eye injury in mining is caused by impact particulate or swirl particulate agents. The former is associated with particles with energy imparted to them causing them to travel virtually in a straight line to reach the eye and the other is associated with much lighter particles which move about with air circulation. Swirl eye injuries are more common and less severe than impact injuries and usually only become serious if not treated in a timely manner.

Emergency Department presentations underestimate the true incidence of eye injury among the coal-mining workforce. There are first-aid stations at all the mine sites in this area staffed by ambulance officers, occupationally trained first aiders or by nurses. Minor trauma is usually dealt with at this level or may be referred to the general practitioner.
Research on industrial injuries, including occupational eye injury is sparse. Eye injuries in Finland in 1973 accounted for 11.9% of all industrial injuries[3]. The US Bureau of Labor Statistics (BLS) reported 65,000 occupational eye injuries or illnesses that involved days away from work in all private industries in 1997 in the USA[4]. Data from other countries, although some of it is quite old, give figures of 10% for Sweden[5], 18% for France[6] and 18.5% for Switzerland[7]. There is no Australian estimation for the proportion of eye injury that is work related but QISU figures place Queensland at the higher end of the published range for work related eye injuries.

The problem of eye injuries in the mining industry has long been identified. In 1950 in the UK there were 20,424 notifiable industrial eye injuries of which 11,058 occurred in mining. This is a rate of 11 per 1000 employees[8]. The only specific paper on eye injuries in the coal industry[10] was based on work in the North Yorkshire area of British Coal Corporation. The research was based on 14,700 workers. There were 12,933 injuries recorded, or 0.88 per employee. Of these 2300 cases involved injury to the eye. This represents 18.0% of the total which is a similar proportion to the Queensland findings. The absolute rates are also similar if allowance is made for the Queensland figures only including hospital presentations.

Any eye injury has potentially serious consequences both from a personal injury perspective and an industrial perspective. A visually impaired worker will be unable to continue working underground due to the requirements for depth of vision in working underground in reduced lighting conditions.

Prevention

It is disappointing that the Central Queensland results are at a similar level to the Yorkshire results of 1989. Furthermore our eye injuries are probably more frequent than those reported for Yorkshire mining because we may have missed a considerable number who did not use the public health systems.

Prevention of mining eye injuries requires improved compliance with the use of appropriate protective eyewear. A search of the literature found only a small number of articles[2,11,12] about compliance rates. A study by de la Hunty[11] investigated 51 patients presenting to a metropolitan Emergency Department with work related eye injuries. The authors found that 6.3% of workers were wearing protective eyewear, 14% of which complied with AS1336 for occupational eye protection. Of these 51 patients 71% had suffered previous eye injuries.

This study found that protective glasses were sometimes being worn where goggles should have been worn. Use of goggles to avoid impact particulate injury was supported by Chou[12] who also noted that the principal hazard in manual spot welding with high current electrodes is high-speed droplets of molten metal produced by the process. The eyes are easily protected using polycarbonate wrap around eye shields but glasses do not provide full protection.

Lipscomb[2] reviewed 7 reports that described eye injury prevention strategies in industry and found that that education of workers is important in reducing eye injuries. The coal mining industry insists on eye protection at all times on site, but education is needed on when goggles should be worn. There is at the moment little robust scientific information on how to educate the worker about the types of protection required and the circumstances when it is to be used. Wraparound safety glasses may achieve better compliance than goggles and may be appropriate in some situation involving particle impact if they approach the safety of goggles.

Eye protection should be both practical and socially acceptable. If eyewear is fashionable workers, particularly younger workers, are more likely to comply with continuous use[13]. Tinted lenses should not be worn by underground workers as they are unnecessary and represent a further hazard to vision. On the other hand the use of yellow tinted lenses for night work on the surface is recommended as they improve definition of terrain. Many workers in areas of high humidity such as underground bolting when the roof is wet complain of fogging of the glasses. An option here is to consider double skinned glasses, such as those used in snow skiing, as they are less prone to fogging up than other designs.

Eye protection is a trade off between protection from impact particulate and from swirl particulate.
Quite often goggles are low impact protection, whereas most glasses are medium impact. People are more likely to accept risk if glasses are uncomfortable or unfashionable. Few people like to wear goggles for any length of time but safety glasses which could offer the best protection from both impact and swirl particulates do not all offer the same degree of protection. Further work is required to determine the best compromise design.

A review of mining companies education and compliance procedures would provide a positive approach to addressing eye injury, along with encouragement to research improved design.

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