Arc welding and the risk of cancer

Anthony Dixon
MBBS, FACRRM, is dermasurgeon and Director of Research, Skin Alert Skin Cancer Clinics and Skincanceronly, Belmont, Victoria. anthony@skincanceronly.com

Case study

Mrs LF, 71 years of age, presents with numerous squamous cell carcinomas (SCCs) on her hands (*Figure 1*). She comments that she had 'perfect' hands until recent years and had never been an 'outdoors person'. On questioning her about trauma or exposure to her hands she commented that she had frequently experienced 'sunburn' on her hands after assisting her son with his welding business.

It turns out her son had started his own handyman business 10 years earlier. Most of the work involved arc welding repair jobs on fences and gates. He had bought a 240 volt welding unit and set up a mobile welding service out of his utility van. He had no money for staff, yet often needed an assistant to hold metal pieces to be welded together. Mum came to his rescue! She describes holding the metal with her bare hands and looking away to either the left or right while her son welded the sections. Her son wore a face mask, but sometimes did not wear gloves due to the hot conditions. This unfavourable health and safety story was supported by examination of Mrs LF's skin. She had marked actinic damage on her hands and forearms, but none on her chest (*Figure 2*), abdomen, back or lower limbs. Her face demonstrated actinic damage and two SCCs. Her neck also demonstrated marked actinic damage with a basal cell carcinoma on the right side (*Figure 3*) and a SCC on the left (*Figure 4*).

Arc welding produces substantial ultraviolet (UV) radiation including the A (400–315 nm), B (315–280 nm) and C (280–100 nm) spectrums. Little is known of the damage that can be caused by UVC because humans are rarely exposed to such short wavelength UV radiation.[1–3] Virtually all solar UVC is absorbed in the atmosphere long before it reaches the earth's surface.[3,4] In contrast, UVC from arc welding is mostly absorbed by air immediately around the arc, but some could reach exposed skin on the welding operator.

The cause and effect relationship between arc welding and skin cancer has not been demonstrated to date, however there has been little research into this occupational hazard. One study showed no increased incidence of skin cancer in welders.[5] However, this study involved a plant with very high health and safety standards and workers were well protected with mask and clothing whenever welding. Greater concern surrounds workplaces where health and safety standards may be suboptimal, such as farmers, sculptors, tradesmen and mechanics who may undertake welding without formal training.[4]

Different welding processes produce variation in the degree of UV exposure for the worker and any assistant. UV exposure is increased with: decreasing proximity to

Figure 1. Numerous SCCs have developed on both hands and forearms on a background of marked actinic damage

Figure 2. The chest, back and lower limbs are without actinic change

Figure 3. The right neck shows a morphoeic BCC

Figure 4. The left neck shows a well differentiated SCC. The face is markedly damaged with smaller SCCs needing attention

Table 1. Welding process and the degree of UV radiation produced

UV level	Welding process	Distance in metres for 1 minute duration before US daily threshold limit of UV is reached while welding mild steel
High	Gas metal arc welding	0.95 m at 90 amps
	Gas tungsten arc welding	0.90 m at 150 amps
Medium	Most shielded metal arc welding including domestic units	3.2 m at 100 amps
Low	Submerged arc welding	Beyond any distance of concern
Minimal or nil	Oxy-acetylene welding	Minimal UV
	Resistance welding	
	Friction welding	
	Friction stir welding	

Source: Lyon TL. Evaluation of the potential hazards for actinic ultraviolet radiation generated by electric welding and cutting arcs. US Army Environmental Hygiene Agency, 1976

the arc, increased arc energy, increased arc duration, higher current and certain angles of plate reflection. Different welding processes produce different UV exposure (*Table 1*).[6] The most intense UV exposure is often associated with welding aluminium or stainless steel where gas metal arc (GMA) or gas tungsten arc (GTA) processes are often used. It is an imperative that arc welders and their assistants wear suitable gloves, forearm clothing, mask, and protection for the neck (*Figure 5, 6*).

Figure 5. An example of unsafe welding practice. Note the bare hands and forearms. The welder is working close to the arc and his neck is also unsafely exposed

Figure 6. A safer GTA welding practice. This welder should also have protection to the back of the neck as well some fume extraction system in place.
Reproduced with permission: Prototype Engineering Centre, 2006

Skin is not the only organ at risk from arc welding.[7] Fumes from the welding process are linked with pulmonary disease and other diseases.[8,9] Eye damage from arc welding is also well established.[10–13]

Summary of important points

- Arc welding may be a contributory cause of skin cancer in some patients, especially when a history of lack of protection is apparent.
- Welders and their assistants need advice regarding suitable protection when arc welding (*Figure 6*).
- Anyone can buy an inexpensive arc welding unit from the hardware store without any training in its use. Part time welders such as farmers and tradesmen may be unaware of the risks.
- Welders should use sunblock for the protection of exposed skin. Some sunscreens specifically include UVC protection and welders can be encouraged to select these products.
- Arc welding aluminium produces the most intense UV radiation due to high arc energies involved and high reflectivity of the metal surface.
- Other occupational causes of skin cancer are usually associated with solar ultraviolet. These include outdoor workers such as road workers, gardeners and farmers.

Conflict of interest: none declared.

References

1. Ultraviolet radiation. World Health Forum 1995;16:110.
2. Merryman JI. Effects of ultraviolet C radiation on cellular proliferation in p53-/- keratinocytes. J Environ Pathol Toxicol Oncol 1999;18:1–9.
3. Horneck G. Quantification of biologically effective environmental UV irradiance. Adv Space Res 2000;26:1983–94.
4. Dixon AJ, Dixon BF. Ultraviolet radiation from welding and possible risk of skin and ocular malignancy. Med J Aust 2004;181:155–7.
5. Emmett EA, Horstman SW. Factors influencing the output of ultraviolet radiation during welding. J Occup Med 1976;18:41–4.
6. Lyon T. Knowing the dangers of actinic ultraviolet emissions. Welding Journal 2002;81:28–30.
7. Gallagher RP, Lee TK. Adverse effects of ultraviolet radiation: a brief review. Prog Biophys Mol Biol 2006;92:119–31.
8. El-Zein M, Infante-Rivard C, Malo JL, Gautrin D. Is metal fume fever a determinant of welding related respiratory symptoms and/or increased bronchial responsiveness? A longitudinal study. Occup Environ Med 2005;62:688–94.
9. Meo SA, Al-Khlaiwi T. Health hazards of welding fumes. Saudi Med J 2003;24:1176–82.
10. Vajdic CM, Kricker A, Giblin M, et al. Artificial ultraviolet radiation and ocular melanoma in Australia. Int J Cancer 2004;112:896–900.
11. Shah CP, Weis E, Lajous M, Shields JA, Shields CL. Intermittent and chronic ultraviolet light exposure and uveal melanoma: a meta-analysis. Ophthalmology 2005;112:1599–607.
12. Lombardi DA, Pannala R, Sorock GS, et al. Welding related occupational eye injuries: a narrative analysis. Inj Prev 2005;11:174–9.
13. Reesal MR, Dufresne RM, Suggett D, Alleyne BC. Welder eye injuries. J Occup Med 1989;31:1003–6.

afp CORRESPONDENCE email: afp@racgp.org.au