DSAC Sub-committee on the Medical Implications of Less Lethal Weapons (DOMILL)

Statement on the medical implications of the use of the Somati RCV9000 Vehicle Mounted Water Cannon

Introduction

1. This statement addresses the use of the Somati RCV9000 Vehicle Mounted Water Cannon as a less-lethal option for dealing with unlawful protest, disorder and threats of violence in the United Kingdom. The statement supercedes an interim statement that considered the medical implication of use in Northern Ireland of the Mol CY NV MSB 18 water cannon; the interim statement was placed in the Library of the House of Commons in July 2002.

Background

2. The role of the DSAC Sub-committee on the Medical Implications of Less Lethal Weapons (DOMILL) is to provide the Secretary of State for the Home Department and the Secretary of State for Northern Ireland with:

   a. Advice on the medical implications of generic classes of less lethal (LL) weapon systems (which includes biophysical, pathological and clinical aspects);

   b. Independent statements on the medical implications of use of specific LL systems, when used according to the formal guidance provided to users;

   c. Advice on the risk of injury from identified LL systems striking specific areas of the body, in a format that would assist users in making tactical decisions, and developing guidance to users to minimise the risk of injury.

3. This advice is in support of the UK Government’s requirements arising from:

   a. Recommendations 69 and 70 of the Patten report into policing in Northern Ireland: (i) a research programme to find an acceptable, effective and less potentially lethal alternative to the Baton Round, (ii) provision of a broader range of public-order equipment to the police;

   b. The desire of the Association of Chief Police Officers (ACPO) to have a wider range of options in conflict management scenarios, including those most commonly associated with self-defence and restraint, maintenance of public order, and the police use of firearms.

In Summer 2000, the Secretary of State for Northern Ireland set up a UK-wide inter-departmental Steering Group to co-ordinate a programme to address both requirements.

4. The second report of the Steering Group described the various classes of LL weapon systems being evaluated to address the requirements. The report categorised the technologies according to the requirement for research and evaluation. Within Category A (devices which may be subject to research and evaluation immediately) were vehicle-mounted and portable water

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1 DSAC Sub-committee on the Medical Implications of Less Lethal Weapons (DOMILL). Interim statement on the medical implications of the use of vehicle-mounted water cannon in a public-order role. DSTL/CBS/BTP/DOC/592/1.0 dated 13 May 02.
2 Defence Scientific Advisory Council.
cannon. The third report of the Steering Group concluded that portable water cannon did not merit further study, and were unsuitable for use as a less-lethal option in a public-order role. The Steering Group took forward the assessment of commercially available vehicle-mounted water cannon.

5. DOMILL was invited to provide, by March 2002, the interim statement on the medical implications of the use of water cannon in a public-order role. Prior to and during this period, the Police Service of Northern Ireland (PSNI) were deploying the MoICY NV MSB 18 water cannon. These cannon had been borrowed from the Belgian police authorities. The interim statement was required to facilitate the consideration of future water cannon use and in particular, the proposal for purchase of water cannon for use by the PSNI.

6. On 18 July 2002, the Northern Ireland Office Minister of State announced that the PSNI - following discussions with the Northern Ireland Policing Board and the Association of Chief Police Officers (ACPO) - would shortly place an order for six new vehicle-mounted water cannon. Upon the announcement, a PSNI, ACPO and Home Office project team took forward the procurement, and following an objective review of the specifications of water cannon from two manufacturers that had responded to a technical requirement, a contract was negotiated with Somati of Belgium to supply six water cannon – the Somati RCV9000 Vehicle Mounted Water Cannon. The first two of these vehicles were accepted by the PSNI in August 2003, subject to a medical statement by DOMILL. ACPO produced guidance on the deployment and use of the water cannon in the UK. The water cannon are a new design, and there is no history of operational use.

7. DOMILL was requested to produce a statement on the medical implications of the use of the Somati RCV9000 within the ACPO Guidance. The Defence Science and Technology Laboratory (Dstl) developed and implemented a technical strategy to gather experimental data to underpin DOMILL’s statement. The strategy was based on the recommendations presented in para. 14 of the interim DOMILL statement. Dstl undertook tests on the MoICY NV MSB 18 water cannon in October 2002, and on the first two Somati RCV9000 vehicles in Belgium in early September 2003.

8. A DOMILL statement was prepared in October 2003. However, familiarisation trials undertaken by PSNI identified technical problems in the first two vehicles that required modifications by the manufacturers. DOMILL withheld its statement until additional tests could be undertaken by Dstl to ensure that the modifications had not increased the injury potential of the systems. The additional tests on the first and second vehicles took place in February 2004; the water jet outputs of the third and fourth vehicles were also determined at the same time. This statement encompasses these data.

Technical approach

9. The approach was two-fold: a comprehensive review of the literature pertinent to water jets, and a comparison of the water jet output and its effect on responding structures selected to predict the principal hazards. The potential injuries from a jet of water are defined thus:

- Primary injuries are those caused directly by the energy of a water jet impacting the human body (including rotational injuries to the head and neck).

- Secondary injuries are those caused by the impact on the human body of street furniture or other debris, energised by the water jet.

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• Tertiary injuries are caused by impact of the body with other items, as a result of the initial event, such as being thrown against a wall or falling.

10. For the literature review, over 500 references and web-sites were reviewed. The documents and web-sites addressed the use of water cannon, and injuries attributed to that use, the physics of water jets, and injuries reported from the impact of water in other scenarios, such as water sports. Dstl reviewed the technical specifications of some of the water cannon used recently in Northern Ireland, Belgium and Germany, and the nominal specification of the Somati water cannon to be purchased. Dstl updated the review to gather any new information published between the interim DOMILL statement (May 2002) and February 2004.

11. The technical assessment comprised the following activities on the Mol and Somati water cannon:

   c. Measurement of the gross fluid output;

   d. Definition of the biologically effective loading within the jets;

   e. Measurement of the contact velocity and acceleration of the head with a rigid object such as a wall or the ground;

   f. Measurement of the initial linear and rotational acceleration of the head/neck assembly following direct or sweeping interaction of the jet with the head, and with the torso;

   g. The distribution of representative debris accelerated by the cannon directed to the ground, and the risk of specific injuries such as ocular trauma;

   h. The risk of primary injury to the torso and head assessed using physical models.

12. Vehicle-mounted water cannon are less accurate than those LL options that are designed to strike specified individuals. However, they can be used in a variety of modes that reduce the energy transferred to the body by the water: spray or diffused output; short bursts of water jets; continuous water jets. The technical assessment used continuous water jets; uses of lower forces, such as spray output, were considered to be less hazardous. Specifically designed force plates of five different diameters were used to measure the force and the pressure (force per unit area) from the jets. Hybrid III automotive dummies and other injury assessment models were exposed to the jets to assess the hazard. The force and pressure from the jets, and the responses of the injury assessment models were determined at a number of ranges, and cannon output pressure settings. The tests in February 2004 to check the output of the first two vehicles after the modifications, and the tests on the third and fourth vehicles, only employed force plates. The ACPO Guidance was reviewed to assess how the risks were to be controlled in operational use.

Conclusions

Literature review

13. On the basis of the review of a diverse body of literature - little of which had direct, substantiated relevance to the medical consequences of the operational use of water cannon or its use in training - the following conclusions are offered.

14. Deaths: There was no evidence in the peer-reviewed journals, press, police or fringe literature reviewed that any person has been killed by the direct or indirect effects of the impact of a jet from a water cannon in appropriate operational use. This conclusion encompasses injuries
directly from the jet impact (primary injury), penetrating or blunt impact injuries from debris and street furniture accelerated by the jet (secondary injury) and the impact of the accelerated human body against solid objects or the ground (tertiary injury).

15. **Life-threatening injuries**: In the world-wide literature, there was an extremely low incidence of injuries that could be classed as life-threatening attributable to, or actually caused by water cannon jets. The Belgian and German police authorities, and the PSNI have no reports of serious or life-threatening injuries to the public that could be attributed to the jet of the Belgian Mol CY NV MSB 18 or the German Ziegler water cannon. It should be recognised however that the use of force of any nature carries a risk of injury.

16. In public order incidents in which water cannon may be deployed, it may be difficult to differentiate injuries arising directly from the use of water cannon, as opposed to those caused by other LL weapons such as batons, kinetic energy projectiles, physical assaults or chemical irritants, in cases where such approaches are also used. This clouded the review of all sources of published information on the use of water cannon, and will have implications for assigning injuries arising from future deployments and use, in the subsequent audit.

**Technical assessment**

17. **Water jet dynamics**: The measured forces and pressures were very variable; this was principally a consequence of the natural structure of water jets, and the difficulties in directing water jets to small experimental targets. Overall, the forces and pressures from the Somati water cannon at maximum pressure were greater than those of the Mol at the same range, although this was not reflected in the variable response of the principal injury model deployed. There was no significant difference between the water output of the four examples of the Somati water cannon.

18. The pressures measured by the force plates were predicted to be sufficient to displace personnel at medium range. At short range, the predicted pressures to the ocular area exceeded a threshold developed from the medical review, and could result in ocular injury.

19. **Response of the injury models**: Unsurprisingly, the responses of the models were also variable. Jets from both types of water cannon directed to the head/neck area could result in high forces that directly accelerate the head/neck assembly. Using a Hybrid III dummy restrained at the torso, the accelerations, forces and moments indicated that according to criteria developed for automotive impact, serious injuries would not be expected, although there was undoubtedly a risk of injury.

20. An unrestrained Hybrid III dummy was accelerated and displaced by the jet, and struck either the ground, or a barrier placed 2 m behind the dummy. The peak accelerations to the head upon the secondary impact were high, and in some cases exceeded the automotive thresholds for serious injury. The high accelerations were observed with the Mol and Somati water cannon. The loads in the neck were also high, and were close to but did not exceed the automotive criteria for serious injury. The loads indicated that there was a risk of injury (“moderate” as defined by the Abbreviated Injury Scale). The Hybrid III dummy does not model the controlled fall of a human; in practice, it is likely that in a human, forces on the head and neck would be less.

21. There was no evidence from the models deployed that there was a significant risk of direct thoracic injury from the jets, arising from body wall deflection. However, in a few of the instances when the dummy was displaced by the jet, high accelerations to the rear of the thorax were observed, as a result of impact with hard surfaces.

22. The application of the water jets to the ground resulted in the acceleration of small pieces of debris to a height that resulted in the risk of non-penetrating impact to standing and seated personnel. The principal risk was impact to the eye.
Overall assessment

23. The hazards identified in the trials have been reviewed in the context of the ACPO Guidance, and the information acquired from the literature survey. It is concluded that the use of the Somati RCV9000 Vehicle Mounted Water Cannon within the ACPO Guidance is unlikely to result in serious or life threatening injuries.

Recommendations

24. Any modifications to the vehicles relevant to the jet output or use of the jets, or any changes to the ACPO Guidance, should be reported promptly to DOMILL.

25. The output of the jets from the two remaining Somati vehicles should be determined prior to operational deployment and use.

26. The maintenance schedule and routine review of the suitability for service of the vehicles should include a check of the calibration of the water pressure sensors in conjunction with the control system.

27. The training syllabus for Water Cannon Commanders, Operators and Drivers should be reviewed by DOMILL to ensure that the medical risks of the use of the system (declared in the ACPO Guidance) are clear and understandable.

28. DOMILL should be advised immediately of any injuries specifically attributable to the operational use of the water cannon, or in training.

29. DOMILL request a joint report from ACPO, the Home Office and the Northern Ireland Office on the operational performance of the Somati water cannon, and the frequency and type of injuries directly or indirectly attributed to the water cannon. It is requested that this report is provided within one year of the formal acceptance of the first four Somati water cannon by PSNI.

Chairman, DSAC Sub-committee on the Medical Implications of Less Lethal Weapons

3rd March 2004