

PCRf Pathology, OP GRITROCK – A biomedical scientist's perspective

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Abstract

The Primary Casualty Receiving Facility (PCRf) Pathology Department was deployed on Operation GRITROCK from October 2014 to April 2015 to support the medical treatment facility on RFA ARGUS. The department deployed with enhanced microbiology capability and effectively became the microbiology reference laboratory for the Joint Operations Area (JOA). A platelet apheresis capability was delivered in the maritime environment for the first time on an active operation.

Introduction

Op GRITROCK saw the first operational activation of the Primary Casualty Receiving Facility (PCRf), RFA ARGUS, since Operation (Op) TELIC in 2003. The mission statement of the PCRf was to deliver assured Role 2 enhanced deployed healthcare for disease (other than Ebola Virus Disease (EVD)) and non-battle injury (DNBI) to the entitled population in support of Op GRITROCK, in order to contribute to the United Kingdom (UK) response to the EVD outbreak in Sierra Leone.

The full configuration according to the PCRf's Force Elements Table (FET) for the Pathology Department stands at four biomedical scientists (BMS) and one consultant pathologist (microbiology or haematology/transfusion), but the manning on Op GRITROCK was reduced to two BMS without a consultant pathologist.

The Pathology Department on PCRf comprises three compartments: the main laboratory (blood sciences) (Figure 1); the microbiology laboratory; and the blood bank/plasma freezer compartment. A wide range of equipment is held in the laboratory on PCRf to deliver a Role 3 capability including full blood sciences, microbiology and mass transfusion capability, in addition to blood donation and apheresis modules.

Pre-deployment preparation and training

The PCRf mobilised and deployed very rapidly and several key decisions had to be made prior to arrival on board. The Blood Supply Team (BST) was engaged to determine blood component holdings for the duration of the Operation. The first shipment of Red Cells Concentrate (RCC) and Fresh Frozen Plasma (FFP) was scheduled to be delivered to the ship in Gibraltar. Additionally, an Emergency Donor Panel



Figure 1. PCRf Main Laboratory.

(EDP) needed to be organised prior to sailing or in the very early stages of the transit, to allow donor blood samples to be taken and tested in the UK prior to arrival in the Joint Operations Area (JOA).

The manning of the department consisted of a Royal Navy Warrant Officer Class 1 and a Royal Air Force Corporal. The skill mix and experience was a good match for this contingency operation, with an individual experienced in deploying and medical microbiology, alongside a newly qualified and trained member of staff. Both members of staff had been on the PCRf during EX MEDICAL ENDEAVOUR 14, so were very familiar with the ship's routines and laboratory set up. Each completed the BMS Operational Training (BMS OP TRG) and Blood Donation, Storage and Supply courses (BDSS) at the BMS Training School, Defence School of Healthcare Education (DSHE), which were considered essential competencies for this operational deployment.

Passage to JOA, Sierra Leone

After sailing, the main focus was on the Combat

Enhancement Training/Force Integration Training (CET/FIT) to get everyone ready in all respects for this deployment. Due to the speed of deployment, there was no opportunity to have any OP GRITROCK specific training prior to sailing, which would have included Personal Protective Equipment (PPE) drills. Staff from the Army Medical Services Training Centre (AMSTC), Strensall, sailed with the ship to Gibraltar and delivered a series of training sessions on what to expect when arriving in Sierra Leone. During this period Standard Operating Procedures (SOPs) were developed and amended to prepare the PCRf for arrival in the JOA. Op GRITROCK specific SOPs were developed for the referral of specimens to and from the Kerry Town EVD Treatment Unit (KTTU) laboratory for cases of unexplained fever. All other procedures were covered by the UK BMS Operational Support and BST SOPs.

Op GRITROCK

On arrival in the JOA, RFA ARGUS provided logistical support for the operation, utilising 820 Naval Air Squadron's Merlin helicopters along with 539 Assault Squadron Royal Marines Landing Craft Vehicle Personnel (LVCP) and Offshore Raiding Craft (ORC). The primary aim was to build infrastructure for the Department for International Development (DfID)-led operation to combat the spread of EVD in Sierra Leone. Op GRITROCK was a completely different deployment from Op TELIC and Op HERRICK, where the focus had been on the management of patients with major trauma, with the majority of the work involving blood transfusion. Being off the coast of West Africa on a contingency operation, the balance shifted to a focus on infectious diseases and microbiology.

As part of Op GRITROCK three laboratories deployed within the JOA. The other laboratories were in the KTTU, manned by four military BMS staff working alongside Public Health England (PHE), and in the Role 2 facility collated with the International Security Advisory Team (ISAT), which was manned by one military BMS. Whilst the KTTU laboratory had access to molecular techniques, the PCRf had the only microbiology capability that included molecular and traditional culture capability. PCRf's test repertoire was also wider than the other laboratories but, unlike KTTU, could not accept positive EVD or high-risk EVD samples as it is not an Advisory Committee on Dangerous Pathogens (ACDP) level 4 accredited laboratory.

Microbiology

In addition to the core equipment in the standard microbiology module enabling culture of organisms, PCRf also had a Quantum Air Technology Portable Compliant Isolator (Class 3 Glove Box), which has formed part of the permanent equipment on board since 2013. This is critical for processing of high-risk samples such as sputum and

was invaluable in enabling processing of stool samples from across the JOA on the operation. PCRf was uplifted for this operation with a BacT/ALERT 3D™60 System for blood cultures, which is an incubator that continuously monitors the samples and alarms if one becomes positive, removing the requirement for a BMS to manually examine and subculture on a daily basis. This latter activity is not only time-consuming, but has the potential to contaminate samples and cause false positive results. A FilmArray® multiplex Polymerase Chain Reaction (PCR) System (1), with the Gastrointestinal (GI), Respiratory and Blood Culture Identification (BCID) panels was also included in the uplift. This is a 'sample in, result out' multiplex PCR, requiring minimal hands-on time and significantly increasing the number of organisms that can be detected. A rapid test for Dengue Fever, the SD BIOLINE Dengue Duo kit for Dengue NS1 antigen and IgG/IgM antibody test, was also included as part of the uplift.

The FilmArray was the most heavily used piece of equipment on Op GRITROCK, especially in the management of diarrhoea and vomiting (D&V) outbreaks. The GI panel screens for 22 targets with a turnaround time of just over an hour. Results are then e-mailed or telephoned to the Military Consultant Microbiologist reach-back service in the UK for interpretation, as quite often several targets are detected. There were four main outbreaks of D&V ashore during the time in the JOA.

The first outbreak indicated *Shigella* or Enteroinvasive *Escherichia coli* (EIEC) from the PCR results obtained at the KTTU laboratory. Samples were sent to the PCRf for culture to distinguish between *Shigella* and EIEC pathogens and *E. coli* was isolated, which was sent to the UK reference laboratory for further analysis and proved to be EIEC. This would not have been detectable with standard culture methods.

The second outbreak was more straightforward, with Norovirus detected in four patients. This is the first time a viral gastroenteritis outbreak has been identified on operations within 24 hours. Previously, stool samples would have been referred back to the UK and results might take weeks to become available.

The initial results of the third outbreak indicated *Shigella* or EIEC. In this instance, traditional culture methods isolated *Shigella boydii* serotype 20 in three patients. The reference laboratory was effectively brought into theatre as the Gastrointestinal Bacteria Reference Unit (GBRU), Public Health England, Colindale, shipped out specialist antisera (*S.boydii* 19 & 20). The PCRf laboratory was able to confirm results consistent with isolates seen in the UK from personnel who had returned during the main Relief in Place (RiP).

During the fourth outbreak, PCR results showed Enterotoxigenic *E. coli* (ETEC) with all samples being culture negative. *E. coli*-like organisms and samples have been saved so an evaluation of the GI panel can be carried out in the future to gain a better understanding of the role of diarrhoeagenic *E. coli* in outbreaks on operations.

The FilmArray multiplex PCR System proved invaluable on Op GRITROCK and demonstrated the success of molecular techniques on operations with a rapid turnaround of results, facilitating patient intervention and outbreak management. There is still a need for traditional culture methods, as was demonstrated in the identification of the *S. boydii* serotype 20 outbreak, and the ability to provide antimicrobial susceptibility profiles. Due to the compact footprint of the system, the FilmArray could be deployed at Role 2 to provide molecular microbiology previously unavailable on smaller, more manoeuvrable Pathology configurations. Other sporadic but significant GI isolates seen on this operation included *Vibrio parahaemolyticus*, *Shigella dysenteriae* serotype 03 and *Cryptosporidium hominus*. Significant microbiology isolates included *Mycoplasma pneumonia* (PCR positive on FilmArray) from a respiratory swab and *Staphylococcus aureus* (PVL positive) from a skin swab. The total number of microbiology requests was 159 with 82% of those generated ashore.

Blood sciences and blood transfusion

The core equipment to support blood sciences consisted of a Beckman Coulter AcT diff Haematology analyser, Instrumentation Laboratory ACL Elite Coagulation analyser, Ortho Clinical Diagnostics VITROS 350 Chemistry analyser and DiaMed ID Micro Typing Blood Transfusion System. The Abbott iSTAT 1 hand held analyser is the Point of Care Blood Gas analyser currently scaled for the Emergency Department (ED), Operating Theatres (OT), Intensive Therapy Unit (ITU) and Haslar Ward. The laboratory also had four blood banks, four plasma freezers, two platelet agitator/incubators and two Barkey plasma therm defrosters. Stocks of Red Cell Concentrate (RCC) and Fresh Frozen Plasma (FFP) were set and monitored by BST with daily updates. No cryoprecipitate (CRYO) was held on board. Platelets were generated by apheresis on board utilising the MCS® Haemonetics Apheresis System. PCRf was also scaled for a Point of Care ROTEM® *delta* Whole Blood Haemostasis System using thromboelastometry, which was managed by Operating Theatre personnel.

Blood Sciences requests were minimal with 134 haematology, 2 transfusion and 212 clinical chemistry test profiles throughout the six months, the majority of the requests being from the RFA ARGUS primary healthcare team. The anticipated influx of requests for malaria screening did not materialise, with only nine requests and no

positive cases identified on PCRf utilising the BinaxNOW Malaria ICT kit and thick/thin film examination.

Two sets of two units of emergency issue O-Negative blood were available at all times to support the Maritime in Transit Care (MiTC) team and Emergency Department. This deployment was the first time that apheresis had been carried out on a maritime platform and the first time that a unit was transferred between military pathology departments, validating this capability for future contingency operations.

Logistical & environmental challenges

The most significant environmental challenge on PCRf was temperature control of all laboratory areas. On occasions, the temperature in the laboratories reached 30°C, with higher temperatures in the PCRf deck housing and ramp. This resulted in equipment failure with the loss of a plasma freezer and a blood bank over the deployment. Temporary solutions to increase airflow were put in place but it is planned that these issues will be resolved in the next refit.

Conclusion

The main focus on Op GRITROCK, unlike previous operations, was DNBI rather than trauma. The team was able to validate apheresis and demonstrate the capability on an active operation in the maritime setting for the first time. The PCRf laboratory was effectively the reference laboratory in the JOA for all units ashore providing blood sciences, malarial films and microbiology support. The Film Array and faecal culture methods proved invaluable in the management of D&V outbreaks. The contribution to the overall operation was, therefore, greater than if the facility had simply supported the PCRf and Role 1 primary health care on RFA ARGUS.

References

1. FilmArray® <http://filmarray.com/> [accessed Mar 15]

Acknowledgements

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