Title:

The Efficacy of Saline Washout Technique in the Management of Exfoliant and Vesicant Chemotherapy Extravasation: An Historical Case Series Report

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Abstract:

This report presents the results from an historical case series of cytotoxic drug extravasations managed by saline washout; its purpose is to assess the efficacy of the procedure based on patient outcome. 89 patients were identified as having experienced a vesicant or exfoliant extravasation from incident reports filed over a 10 year period, from 1st April 2001 – 31st March 2011. Outcome was measured against the need for further surgical treatment being required. Of the 89 cases assessed for efficacy of saline washout one patient experienced a wound infection which was treated effectively with oral antibiotics. There were no other complications reported and no patients required further treatment with surgical debridement. The majority of patients had no deferral of treatment as chemotherapy could be continued in their unaffected arm immediately following saline washout procedure. For patients where cannulation in their opposite arm for continuation of treatment was not advisable chemotherapy was delayed between 3 to 7 days. Hospitalisation as a result of the extravasation or subsequent treatment was not required in any of the 89 cases. Results indicate that saline washout technique is a safe and effective management strategy for the treatment of both vesicant and exfoliant chemotherapy extravasation.

Key words:

Extravasation, exfoliant chemotherapy, vesicant chemotherapy, saline washout technique.

Main Text:

Introduction

Extravasation, the inadvertent administration of intravenous medications (chemotherapy) into the surrounding tissues rather than into the vascular pathway as intended (Allwood, Stanley and Wright 2002, Dougherty and Lister 2008, RCN 2010) has been characterised in the literature as a 'dreaded complication of chemotherapy' or a 'catastrophe' (Schrivers 2003 p26, Thakur 2008 p145). The outcome of an ineffectually managed extravasation can be potentially devastating, due to the ability of some drugs to cause severe tissue destruction if extravasated (Ener et al 2004, Arroyo et al 2010, Roe 2011, Schulmeister 2011). With Gault (2003) being of the opinion that the long term complications associated with an extravasation injury can be more disabling than the primary disease.

Over the past fifty years since the introduction of systemic chemotherapy as a treatment for the management of both solid and haematological malignancies there has been a continuous steady rise in its use. Recent statistics indicate that there are around 309,500 new cases of cancer (excluding non-melanoma skin cancer) diagnosed each year in the UK (Cancer Research UK 2011), with the vast majority of cases (75%) diagnosed in people over the age of 60 (Cancer Research UK 2011), therefore concurrent with our ageing population it can be expected that this figure will continue to rise. Parallel to this the use of chemotherapy in the United Kingdom has been shown to have increased by up to 60% over the 4 years from 2005 – 2009 (DOH 2009). This increasing use of cytotoxic drug therapy, the increasing complexity and efficacy of chemotherapy regimens, the continuous introduction of new systemic anti cancer therapies resulting in cancer now being classified as a chronic illness, means that over 1.8 million people now live 'with and beyond a cancer diagnosis' (DOH 2011b, p7). The associated fact that these people are now able to receive multiple courses of chemotherapy treatments over a number of years all impacts on the potential for the number of cytotoxic drug extravasations to increase.

Add to this the recent rise in litigation cases relating to patient outcome following extravasation (Schulmeister 2008a, Dougherty 2010) and it becomes vital that institutions have access to a management strategy that is both clinically effective and cost effective. Despite this, controversy continues in regard to the most appropriate treatment and management strategies that should be employed when an extravasation does occur.

It is acknowledged that whilst healthcare providers take every precaution to prevent extravasation, it can still occur despite the experience, skill and knowledge of the practitioner administering the cytotoxic chemotherapy (Dougherty 2010, Schulmeister 2011).

Consequently in order to improve practice, reduce the risk of extravasation and in turn the risk of litigation there is a clear consensus of opinion that the key factor in the effective management of extravasation is staff education, supported by up to date institutional policies and procedures in order to enable the early detection of extravasation and to facilitate prompt intervention (EONS 2007, UKONS 2008, Dougherty 2010, Schulmeister 2011). This conclusion is supported by the recently published chemotherapy measures (DOH 2011a) which specify that all clinical chemotherapy services must have policies and procedures in place to ensure staff administering chemotherapy have had their competency assessed (Measure no's 11-3S-116, 11-3S-118) and that there should be policies and procedures in place for chemotherapy administration techniques (Measure no 11-3S-123) and for systemic therapy acute oncology presentations which include the recognition and treatment of cytotoxic extravasation (Measure no 11-3S-124). It should however be noted that due to the recognised lack of evidence these measures do not advocate which extravasation management strategy should be used.

There are currently five documented management strategies that can be used following cytotoxic drug extravasation, dependant on the category of the extravasated drug, volume and site of extravasation, local expertise and historical practice within institutions. These are the conservative strategy of 'watch and wait', surgical intervention, the topical application of ice or heat, the use of various antidotes, or saline washout technique (Dougherty and Oakley 2011, Schulmeister 2011, Steiert et al 2011).

Within the author's institution (a major Cancer Centre in South East England) saline washout technique as developed by Gault (1993) has been used as the sole management strategy for vesicant and exfoliant cytotoxic drug extravasation for over 10 years (Table 1). In light of the current controversy as to the optimum management strategy for cytotoxic drug extravasation, particularly in regard to the management of anthracycline extravasations, the opinion that there is a lack of published data to support the use of saline washout technique (Roe 2011) and the view that its success is limited (Schulmeister 2011), it was thought both prudent and appropriate to review the centres historical outcome data. Also, taking into account the opinion of Steiert et al (2011) that a lack of published data on the outcome of saline washout technique as a therapeutic option for cytotoxic drug extravasations means that it has 'not yet achieved the level of clinical significance that it rightfully should' (p243) this data will add to the limited body of knowledge currently available about the efficacy of saline washout technique based on patient outcome.

Cancer Centre protocol for extravasation management

Until October 2006, any patient who experienced a vesicant or exfoliant drug extravasation (Table 1) was referred immediately to the plastic surgery team on site at the Cancer Centre for saline washout procedure using the Gault technique; this meant that any extravasation was treated within a few hours of its occurrence.

In his paper in 1993 Gault felt that saline washout was most effective if undertaken within 1 hour of drug extravasation. There have however been no further studies to either support or refute this statement, with the study by Steiert et al (2011) documenting the maximum time to washout as being 14 hours, the protocol published by Dougherty and Oakley (2011) advocating referral for washout within 2 hours and Schulmeister (2011) quoting the ideal as being within 6 hours. The underlying rationale being to wash any DNA binding drug out of

the tissues before it is able to intercalate with the cell's DNA, but yet again it has to be acknowledged that the exact time frame for this is unknown.

In October 2006, the plastic surgery department was moved 27 miles 'off site' from the Cancer Centre to a local district general hospital (DGH), this move has resulted in patients having an unavoidable delay in time to treatment, with the minimum time between vesicant or exfoliant drug extravasation and saline washout being 4 hours and the maximum time to saline washout being 16 hours.

It must be noted that the classification of these drugs can vary dependant on author and that as often acknowledged in the SmPC the pharmacological properties of some are still not fully understood, as a result drugs with conflicting classifications are marked with an asterisk *.

Data collection

All cytotoxic drug extravasation incidents that occur within the cancer centre are documented and a record kept by the Trust. This is in accordance with international recommendations (EONS 2007, UKONS 2008, Dougherty 2010, Schulmeister 2011) that data should routinely be collected from all patients who experience a cytotoxic drug extravasation during the intravenous administration of chemotherapy. All extravasations as identified from incident reports filed at the authors institution over a 10 year period, from 1st April 2001 – 31st March 2011 were reviewed and 147 patients were initially identified as being reported to have experienced an extravasation of either a vesicant or exfoliant (group 4 or 5) chemotherapeutic agent (table 1). Data was then collected from the Trust incident forms and from annotations the patient's medical notes.

This number of reported extravasations was referenced against the total number of chemotherapy administration each year at the Cancer Centre and compared against the figures reported in the literature that 0.01% - 6.5% of all cytotoxic drug administrations' will result in an extravasation (Albanell and Baselga 2000, Schulmeister 2011). Subsequently, the mean incident rate of extravasation at the Cancer Centre was calculated as being 0.36%.

Method and outcome analysis measures

Schulmeister (2011) and Mourisden (2007) both cite lack of diagnostic verification (punch biopsy and fluorescence microscopy) to confirm extravasation as their main criticism of other case series. As the use of punch biopsy is not recognised as being standard practice within the United Kingdom to confirm extravasation and as this is an historical case series, the diagnosis of extravasation was made following 'standard practice' for recognition of the immediate manifestations of an extravasation (Dougherty 2010, EONS 2007). Extravasation assessment criteria are shown in table 2.

The utilisation of punch biopsy to confirm extravasation as an addition to practice would also have significant cost and training implications, including the cost of additional staff training to perform the punch biopsy, extra strain on staff workload and time, alongside the subsequent increase in laboratory costs.

The effectiveness of saline washout was evaluated by reviewing the patients' medical notes (all medical correspondence, clerking notes, nursing documentation and referral letters) and recording all entries with reference to the extravasation for up to twelve weeks following the

initial treatment with saline washout technique. The annotations were recorded using a pre defined data collection tool (Figure 1) and catalogued anonymously.

Outcome was determined by grouping the results into three categories: No further treatment required, sequalae documented and surgical debridement required. As with the prospective multicentre studies published by Mourisden et al (2007), the outcome measure used was that the intervention be judged effective if the patient did not require surgery (surgical debridement) as a consequence of the extravasation (p548).

Patient data

Of the 147 patients initially identified, 7 patients were immediately excluded from the data analysis as 5 patients had been reported twice and 2 patients had been incorrectly reported with the extravasated drug not being a chemotherapeutic agent, plus a further 2 patients had presented with late symptoms not confirmed as being the result of an extravasation. A breakdown of the resulting 138 cases of extravasation by year is shown in table 3. Thirteen patients had not had saline washout procedure carried out as the clinicians had instead opted for a 'watch and wait' policy and a further 36 sets of notes had gone into storage off site and were therefore unavailable to review. This resulted in a total of 89 patients being included in the data analysis as assessable for outcome.

Patient demographics

The divide between male and female patients was similar, with 54% male (n=48) and 46% female (n=41) being included in the final analysis. There was a diverse age range from 18 to 79 years; the mean age being 59 years and the median age 58 years.

The extravasation of vesicant chemotherapy accounted for 38% (34 patients) with 55 patients (62%) treated for the extravasation of exfoliant chemotherapy. Epirubicin a DNA binding anthracycline accounted for 16 (18%) of all extravasations included in the data set. Tumour sites varied, with the majority of patients (30%) having a diagnosis of colorectal cancer and 18% a diagnosis of breast cancer. Of the 34 patients who experienced a vesicant drug extravasation 23 were female (Tables 4 and 5).

Location of treatment and mean time to intervention

Of the total 89 patients, 36 had been treated by plastic surgeons 'on-site' at the cancer centre and 52 patients were treated 'off-site' 27 miles away by the on call plastic surgery team at the district general hospital (DGH). The time saline washout procedure had been carried out was only documented in the cancer centre notes for 29 cases. Only 7 of the 52 patients treated off site had the time of procedure recorded in the cancer centres medical notes. A referral letter would have been sent with the patient, to the plastic surgeons and the procedure documented in the patient's surgical notes, however access was not requested from the DGH to examine patient's surgical notes as part of this review.
Of the 29 patients notes where time to treat had been documented the range was from 10 minutes for a vesicant extravasation, to over 12 hours for two exfoliant extravasations. The mean time to treatment was 175 minutes, with a median time to treat of 130 minutes.

Technique specified

The cancer centre has a recognised protocol used for saline washout technique specifying that the area should first be infiltrated with hyaluronidase and then flushed through with saline, but it does not specify the exact amount of saline to be used. This is subject to clinicians judgement, dependant on the size of extravasation noted, evidence of erythema, swelling, induration or volume of extravasate. The volume of saline used for the procedure was specified in 40 of the 89 cases, again as noted above this is due to the procedure being carried out 'off site' and annotations being made in the surgical notes. However in the annotated notes it was found that the volume of saline used for the procedure varied from 50mls – 1000mls, the average volume of saline used being 400mls.

Outcome / Efficacy

Patient outcome following use of saline washout technique was assessed from annotations made in the patient's medical notes up to sixteen weeks following their extravasation (Table 6). In accord with the criteria utilised by Mourisden et al (2007) to determine efficacy, use of saline washout technique proved 100% effective, i.e. none of the 89 patients had surgery as a consequence of the extravasation. In addition none of the 89 patients experienced any degree of tissue necrosis or had any permanent physical damage following the procedure and use of saline washout is not associated with any clinical toxicy.

Sequalae

In the DNA binding vesicant group managed by use of saline washout, three patients experienced some minor bruising which quickly resolved, one patient had some mild erythema noted at 3 week follow up and one patient had residual inflammation 16 weeks post washout which settled with no further problems noted. There were no other complications such as induration, exfoliation, ulcer development or tissue necrosis reported and no patients required surgery.

In the non DNA binding vesicant group 4 patients experienced some mild tenderness and erythema for up to 14 days after the procedure, all of which resolved within 21 days. One patient experienced a wound infection 14 days after the procedure which was treated effectively with oral antibiotics. Surgical debridement was not required.

In the exfoliant group 15 patients (27%) experienced mild sequalae ranging from minimal bruising (6 patients), tenderness and mild erythema (3 patients) and cellulitis (6 patients) for which 4 patients required treatment with oral antibiotics. No other complications such as exfoliation, ulceration or necrosis were reported and no patients required surgery.

Length of delay to ongoing chemotherapy treatment

The majority of patients had no deferral of treatment as chemotherapy could be continued in their unaffected arm immediately following saline washout procedure. Three patients declined the remainder of their treatment for this cycle but continued with no delay to subsequent cycles, one patient had a delay to the next cycle as a result of residual cellulitis and one patient refused further chemotherapy stopping at cycle 5 of a planned 6 cycles of treatment for metastatic breast cancer.

Whilst it is acknowledged that supporting evidence is sparse, it is widely accepted that breast cancer patients who have undergone axillary node clearance should avoid cannulation on their affected side (Cole 2006) so for this reason cannulation in their opposite arm for

continuation of treatment was not an option. For these patients, their chemotherapy was therefore delayed between 3 to 7 days. One patient was delayed for 4 days to allow a central venous access device (CVAD) to be placed as further peripheral access was not possible. Hospitalisation as a result of the extravasation or subsequent treatment was not required in any of the 89 cases.

Discussion

Following the recent publications by Dougherty and Oakley (2011) and Steiert (2011) this historical case series further supports the view that saline washout technique is a safe and effective strategy for the management of cytotoxic drug extravasation. Whilst it must be acknowledged that it is impossible to directly compare results from various case series due to the unaccounted variables such as drug concentration, dose, site etc. the outcome measure used to determine acceptable and effective outcome in the studies by Steiert (2011), Dougherty and Oakley (2011) and Mourisden et al (2007) are all the same: Avoidance of further surgical intervention.

In the case series report of Steiert et al (2011) none of the 13 patients assessed for efficacy of saline washout procedure (SWOP) following extravasation (which included 9 vesicant extravasations) had any further complications such as tissue ulceration or subcutaneous tissue necrosis.

In the article by Dougherty and Oakley (2011), whilst not documenting the nature of the extravasated drugs, they report a total of 6 flush out procedures performed with no patients requiring further intervention from the plastics team or experiencing any permanent physical damage.

Of the 89 extravasations (including 16 anthracycline extravasations) assessed for efficacy of saline washout procedure as reported in this paper, none had any further complications such as tissue ulceration or subcutaneous tissue necrosis or required further treatment with surgical debridement.

It must however be recognised that saline washout technique should only be carried out by experienced Health Care Professionals who have been appropriately trained and assessed as competent in the procedure. Although as Dougherty and Oakley (2011) have demonstrated this procedure is no longer limited to plastic surgeons and therefore recommend it becomes embedded into chemotherapy nursing practice, being easily incorporated into an advanced nurse practitioners role.

As awareness and access to saline washout technique increases it is important to recognise that there are varying methods of saline washout that have developed following the initial publication by David Gault in 1993, which could potentially result in the procedure becoming ‘too adapted’ and risk it becoming less effective. It is therefore recommended that a full risk assessment should be completed when making a decision about the extravasation management strategy of choice and that where cancer networks do not have access to the necessary expertise required to undertake saline washout procedure the appropriate antidote should always be used.

The limitations of this historical data analysis are acknowledged. Being retrospective it is dependent on the clinician's annotations within the medical notes to confirm the diagnosis of extravasation. No photographic evidence was available to support the diagnosis. There was a significant lack of documentation in regarding the procedures carried out off site. However despite the retrospective nature of the data, the efficacy of saline washout being judged entirely on the patient not requiring any surgical resection is the same outcome measure as used in publications reporting the efficacy of dexrazoxane in the management of anthracycline extravasation (Mourisden et al 2007, Tyson and Gay 2010, Fontaine et al 2012).

Conclusion

It is recommended that further prospective studies would be useful to identify and grade residual soft tissue damage following intervention with any extravasation management strategy and to determine the impact this has on the patient. Also one key aspect that must be noted is that whilst Mourisden et al (2007) and Steiert et al (2011) document the toxicities and sequalae experienced following extravasation management, none of the sourced literature documents or alludes to the patient's perspective in regard to outcome.

In the current economic climate there is an increasing awareness of the need to improve understanding of the comparative clinical effectiveness of healthcare interventions, with the Department of Health (March 2010a) focusing on the drive to maximize quality and improve patient experience with its QIPP philosophy of how the NHS must do business. It is also recognised that in some circumstances the strength of randomised controlled trials has limited applicability (Olsen and Mc Ginness 2010) and the use of alternative research strategies and sources to inform practice are more appropriate. The DOH white paper Equity and Excellence: Liberating the NHS (2010b), whilst acknowledging that doctors and nurses must be able to use their professional judgement about what is right for patients, also advocates that clinicians ensure shared decision making and consider the information patients can utilize in making an informed choice about the treatment they receive, the guiding principle being 'No decision about me, without me'.

Therefore, taking into account the ethical and practical limitations of randomised clinical trials, resulting in research studies being unable to demonstrate a clinical superiority of either management strategy plus the government's philosophy for healthcare provision, it is suggested that future studies should start to focus on exploring the patient's experience of extravasation and its subsequent management in relation to the clinical outcome.

REFERENCES

Albanell and Baselga (2000)
Systemic Therapy Emergencies
Seminars in Oncology
Vol 27, no 3, p 347 – 361

Allwood M, Stanley A, Wright P (Eds) (2002)
The Cytotoxic Handbook 4th Edition
Radcliffe Medical Press Ltd Oxford

Arroyo PA, Perez RU, Feijoo MA, Hernandez MA (2010)
Good clinical and cost outcomes using dexrazoxane to treat accidental epirubicin extravasation.
J Can Res Therapy
Vol 6, p573-4
http://www.cancerjournal.net/text.asp?2010/6/4/573/77081

Cancer Research UK (2011)
http://publications.cancerresearchuk.org/downloads/product/CS_REPORT_TOP20INCMORT.pdf - Last accessed 16/03/2012

Cole T (2006)
Risks and benefits of needle use in patients after axillary node surgery.
British Journal of Nursing
Oct 12-25, vol 15, no18, p 969-74

Department of Health (2009)
Chemotherapy Services in England: Ensuring Quality and Safety
A report from the National Chemotherapy Advisory Group
Gateway reference no: 12208
http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_104501.pdf
Last accessed 16/03/2012

Department of Health (2010a)
The NHS QIPP Challenge: An introduction for clinicians.
http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_113806
Last accessed 24/06/2011

Department Of Health (2010b)

The NHS White Paper – Equity and Excellence: Liberating the NHS
http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/@ps/documents/digitalas_117352.pdf Last accessed 22/06/2011
Last accessed 24/06/2011

Department of Health (2011a)
National Cancer Peer Review – National Cancer Action Team (NCAT)
Chemotherapy Measures v1.0 (2011)
Manual for Cancer Services
Gateway reference no:16104
http://www.dh.gov.uk/en/Consultations/Responsestoconsultations/DH_127744
Last accessed 16/03/2012

Department of Health (2011b)
Improving Outcomes: A Strategy for Cancer
Gateway reference no:15108
http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_123371
Last accessed 06/05/2011

Dougherty L and Lister S (Eds) (2008)
Drug Administration: Cytotoxic Drugs
In: The Royal Marsden Hospital Manual of Clinical Nursing Procedures
7th Edition
Wiley-Blackwell Publishing
Chichester UK
Chapter 12, p 255 – 288

Dougherty L (2010)
Extravasation: Prevention, recognition and Management
Nursing Standard
Vol 24, no 52, p 48-55

Dougherty L and Oakley C (2011)
Advanced Practice in the management of extravasation
Cancer Nursing Practice
Vol 10, no 5, p16 – 22

Electronic Medical Compendium (eMC)
SmPC for dimethylsulphoxide (DMSO)
http://www.medicines.org.uk/emc/medicine/2258
Last accessed 01/04/2012

Ener R, Meglathery S, Styler M (2004)
Extravasation of systemic haemato-oncological therapies
Annals of Oncology
Vol 15, no 6, p 858 -862

European Oncology Nursing Society (EONS) (2007)
Extravasation Guidelines Implementation Toolkit
http://www.cancernurse.eu/documents/EONSClinicalGuidelinesSection6-en.pdf
Last accessed 22/04/2011

Fontaine C, Noens L, Pierre P, DeGreve J (2012)
Savene (Dexrazoxane) Use in Clinical Practice
Support Care Cancer. Short communication.
Published on line Springer-Verlag
DO1 10.1007/s00520-012-1382-2 27/01/2012

Gault D T (1993)
Extravasation Injuries
British Journal of Plastic Surgery
Vol 46, no 2, p 91 – 96

Mourisden HT, Langer SW, Butler J, Eidtmann H, Rosti G, De Wit M, Knoblauch P, Rasmussen A, Dahlstrom K, Jensen PB, Giaccone G (2007)
Treatment of anthracycline extravasation with Savene® (Dexrazoxane): Results from two prospective clinical multicentre studies.
Annals of Oncology
Vol 18, no 3, p 546-550

Olsen AL and Mc Ginness JM (2010)
Redesigning the Clinical Effectiveness Research Paradigm: Innovation and Practice Based Approaches: Workshop Summary
IOM (Institute of Medicine)
The National Academies Press
Washington DC
ISBN:0-309-11989-8

RCN (2010)
Standards of Infusion Therapy
RCN IV Therapy Forum
3rd Edition
RCN Publishers
London
ISBN:978-1-906633-19-6

Roe H (2011)
Anthracycline Extravasations: prevention and management
British Journal of Nursing
Vol 20, (Oncology supplement), No 17, p 16-22

Schrijvers DL (2003)
Extravasation: a dreaded complication of chemotherapy
Annals of Oncology

Vol 14, (supplement no 3), piii26-iiii30

Schulmeister L (2008)
Managing Vesicant Extravasations
The Oncologist
Vol 13, p284-288

Schulmeister L (2011)
Extravasation Management: Clinical Update
Seminars in Oncology Nursing
Vol 27, no1, p 82 – 90

Steiert A, Hille U, Burke W, Gohritz A, Zilz S, Herold C, Vogt PM (2011)
Subcutaneous wash-out procedure (SWOP) for the treatment of chemotherapeutic extravasations
Journal of plastic, reconstructive and aesthetic surgery
Vol 64, p240-247

Thakur JS, Chauhan CGS, Diwana VK, Chauhan DC, Thakur A(2008)
Extravasational side effects of cytotoxic drugs; a preventable catastrophe
Indian J Plastic Surgery
Vol 41, p 145-150

Tyson AM and Gay WE (2010)
Successful Experience Utilizing Dexrazoxane Treatment for an Anthracycline Extravasation
The Annals of Pharmacotherapy
Vol 44, p 922 - 925

UK National Extravasation Service (2007)
www.extravasation.org.uk – last accessed 22/04/2011

United Kingdom Oncology Nursing Society (UKONS) (2008)
Anthracycline Extravasation Management Guidelines
www.ukons.org

Table 1 Examples of cytotoxic drugs documented as having vesicant or exfoliant potential

Vesicants – Group 5 classification		Exfoliants – Group 4 classification
Amsacrine *	*(DNA Binding)*	Adarubicin
Bendamustine *		Cisplatin
Carmustine		Docetaxol (Taxotere) *
Chlormethine	*(DNA Binding)*	Liposomal Daunorubicin
Dacarbazine		Floxuridine
Dactinomycin	*(DNA Binding)*	Oxaliplatin *
Daunorubicin	*(DNA Binding)*	Topotecan
Doxorubicin	*(DNA Binding)*	
Epirubicin	*(DNA Binding)*	
Idarubicin	*(DNA Binding)*	
Mitomycin	*(DNA Binding)*	
Mitoxantrone *	*(DNA Binding)*	
Mechlorethamine	*(DNA Binding)*	
Paclitaxel		
Streptozocin		
Trabectin	*(DNA Binding)*	
Treosulphan		
Vinblastine		
Vincristine		
Vindesine		
Vinorelbine		

Adapted from:
Schrivers 2003, Schulmeister 2011, www.extravasation.org.uk and from http://www.medicines.org.uk/emc/

Table 2
Extravasation criteria

Adapted from: European Oncology Nursing Society (EONS) Extravasation Guidelines Implementation Toolkit (2007),
Dougherty L. Extravasation: Prevention, recognition and Management. Nursing Standard (2010) Vol 24, no 52, p 48-55

Characteristic	Flare reaction	Vessel irritation	Venous shock	Extravasation
Presenting symptoms	Itchy blotches or hives	Aching and tightness	Muscular wall of blood vessel in spasm	Tenderness, pain, stinging and /or burning during drug administration at the venepuncture site, non-coring needle injection site or CVAD entry / exit site.
Colouration	Red raised blotches / diffuse or irregular hive like erythema	Dark discolouration or erythema tracking along the vessel (if peripheral venous cannula in situ)		Erythema around the venepuncture site, non-coring needle injection site or CVAD entry / exit site. (Not always present immediately)
Swelling	Unlikely	Unlikely		Some oedema likely to be present (Often difficult to identify immediately)
Blood return	Usually remains if previously present	Usually remains if previously present	Often absent or lost if previously present.	Often misleading as blood return can still be present if an extravasation has occurred. Loss of blood return if previously present may predispose extravasation.
Other				Leakage of drug at or around the administration site
Timing	Usually appears suddenly and dissipates within 30-90 minutes	Usually appears within minutes after drug administration, although tracking may appear later in the process	Usually appears immediately, but can occur at any time during the administration process	Can occur at any time during the administration process

Table 3
Reported extravasations by year (*1st April – 31st March*)

	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	Total
Vesicants											
Epirubicin	1	2	1	1	2	6	1	0	2	2	18
Dacarbazine	0	0	0	1	0	0	1	0	0	2	4
Mitomycin	0	0	0	0	0	0	0	0	0	0	0
Paclitaxel	1	0	2	2	1	1	1	3	1	3	15
Vinblastine	0	0	0	1	0	0	1	0	0	0	2
Vincristine	0	0	0	0	0	1	0	0	0	0	1
Vinorelbine	0	0	0	1	0	0	0	5	0	2	8
Exfoliants											
Cisplatin	2	1	2	7	7	3	5	7	5	2	41
Docetaxol	0	0	0	1	0	0	0	0	2	2	5
Mitoxantrone	0	0	0	0	0	0	0	0	0	0	0
Oxaliplatin	1	3	3	3	6	5	4	8	7	4	44
Totals	5	6	8	17	16	16	13	23	17	17	**138**

Table 4
Patient demographics

Drug, category, tumour site and regimen	Male	Female	Total
Epirubicin - *DNA binding vesicant (5)*	2	14	16
Tumour Site / Regimen	1 x Upper GI / EOX 1 x Colorectal / ECX	3 x Breast / Single agent 9 x Breast / FEC 2 x GI / ECX	
Dacarbazine - *Non DNA binding vesicant(5)*	3	0	3
Tumour Site / Regimen	2 x Hodgkin's / ABVD 1 x Melanoma / single agent		
Paclitaxel - *Non DNA binding vesicant(5)*	2	6	8
Tumour Site/ Regimen	1 x Melanoma / Taxol & Combre 1 x Urothelial / Trial GTC	5 x Ovarian / Taxol & Carboplatin 1 x Breast / Gem & Taxol	
Vinorelbine - *Non DNA binding vesicant(5)*	2	3	5
Tumour Site/ Regimen	2 x Lung / VP	1 x Breast / Vinor & Herceptin 1 X Breast / single agent 1 x Lung / VP	
Vincristine - *Non DNA binding vesicant(5)*	1	0	1
Tumour Site/ Regimen	1 x NHL / CHOP-R		
Vinblastine - *Non DNA binding vesicant(5)*	1	0	1
Tumour Site/ Regimen	1 x Bladder / MVC		
Docetaxel - *Non DNA binding exfoliant(4)*	2	1	3
Tumour Site/ Regimen	2 x Prostate / single agent	1 x Breast / FEC-T	
Oxaliplatin - *Non DNA binding exfoliant(4)*	22	5	27
Tumour Site/ Regimen	11 x Colorectal / Xelox 8 x Colorectal / Folfox 2 x Rectal / Socrates 1 x Oesophageal / chemo-rad	4 x Colorectal / Folfox 1 x Colorectal / Xelox	
Cisplatin - *Non DNA binding exfoliant(4)*	13	12	25
Tumour Site/ Regimen	1 x SCLC / EP 2 x Oesophageal / ECX 1 x Oesophageal / Herskovic 2 x Germ cell / BEP 1 x Germ cell / TIP 1 x Mesothelioma / PP 1 x Lymphoma / R-ESHAP 1 x HD / ESHAP 1 x NHL / ESHAP 1 x Bladder / MVC 1 x Tongue / Chemo - rad	2 x Cervix / PMB 2 x Cervix / chemo-rad 3 x Oesophageal / Herskovic 2 x Germ cell / BEP 2 x Ovarian / EP 1 x NHL / ESHAP	
Total	48	41	89

Table 5

Total number of vesicant and exfoliant extravasations

Key: DNA Binding vesicants = category A, Non DNA binding vesicants = category B, Exfoliants = category C

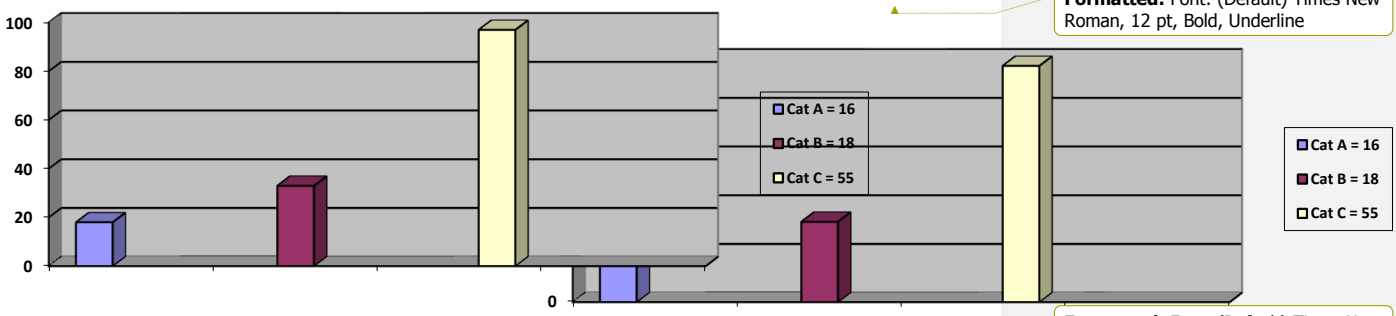

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Table 6
Incidence of sequalae following saline washout

Drug	No reported Sequalae	Short term complications	Surgical intervention required
DNA Binding vesicant (n=16) *Epirubicin(16 patients)*	11 patients	2 patients – minimal bruising 1 day post washout. Settled with no further problems noted. 1 patient – slight residual bruising 1 week post washout. Settled with no further problems noted. 1 patient – mild erythema to site 3 weeks post washout. Settled with no further problems noted. 1 patient – minor inflammation at site noted 16 weeks post washout, but no induration, ulceration or tissue breakdown. Settled with no further problems noted.	No surgical intervention required
Non DNA Binding vesicant (n=18) *Dacarbazine(3 patients)* *Paclitaxel(8 patients)* *Vincristine(1 patients)* *Vinorelbine (5 patients)* *Vinblastine (1 patient)*	13 patients	**Dacarbazine:** 1 patient – skin healed but tender 14 days post washout. Settled with no further problems noted. **Paclitaxel:** 1 patient – some tenderness and erythema 1 day post washout. Settled with no further problems noted. **Vincristine:** 1 patient – mild redness noted 7 weeks post washout. Settled with no further problems noted. **Vinorelbine:** 1 patient – area tender 12 days post washout, nil else of note, settled with no further problems. 1 patient – wound infection developed 2 weeks post washout. Treated with antibiotics. No further sequalae noted.	No surgical intervention required
Exfoliant (n= 55) *Docetaxel (3 patients)* *Cisplatin(25 patients)* *Oxaliplatin(27 patients)*	40 patients	**Docetaxel:** 1 patient - Some cellulitis noted 10 days post washout. Settled with no further problems noted. 1 patient– some cellulitis noted 3 weeks post washout. Settled with no further problems noted. **Cisplatin:** 3 patients - arm bruised / tender 1 day post washout. Settled with no further problems noted. 2 patients - minimal bruising 2 days post washout. Settled with no further problems noted. **Oxaliplatin:** 1 patient – treated with oral antibiotics at 9 days post washout due to mild cellulitis. Some induration noted at 20 days post, no further complications documented. 1 patient – still some erythema and tenderness 12 days post washout, mild analgesia required. Settled with no further problems noted. 1 patient – slight bruising, discolouration and ache14 days post washout. Settled with no further problems noted. 1 patient – some erythema and swelling 15 days post washout. 28 days later – all settled. 2 patients – cellulitis treated with oral antibiotics at 21 days post washout. Area remained inflamed (no desquamation) up to 35 days post washout, then settled with no further complications. 1 patient – slight soreness at site with intermittent swelling at 23 days post washout, able to perform all ADL. Settled with no further problems noted. 1 patient – persistent cellulitis at 31 days post washout. Improvement	No surgical intervention required

		noted at 49 days with no further problems noted.	

Figure 1
Data collection tool

Date of extravasation:	**Time of extravasation**
Age: *(at time of extravasation)*	**Sex: M F**
Diagnosis:	**Treatment intent: Adjuvant, Neo-adjuvant, Palliative**
Regimen:	**Extravasated drug:**
Cycle:	**Dose (mgs)**
Site of extravasation: Wrist, dorsum of hand, forearm, ACF, other	
Immediate action taken: Aspiration attempted, Ice and elevate, Heat and elevate,	
Documentation: **Nursing** **Oncology team :**	
Delay, interruption or deferral of treatment?	
Time seen by plastics team:	**Seen at: Cancer Centre / DGH**
Treatment by plastics team as documented in notes:	

Volume of saline used in washout: **Hyaluronidase used: Yes / No**
Delay to treatment documented:
Further documentation and dates: *(continue overleaf)*