EFFECT OF OPSITE SPRAY DRESSING ON INTEGRITY OF EPIDURAL CATHETERS: A LABORATORY BASED OBSERVATIONAL STUDY

Niamat Aldamluji[1,2,3*], MBChB, FRCA, FCAI, MSc, EDRA, DA, Ayodele Obideyi[1,2,3], MBChB, DA, FWACS, FRCA, FCAI, Karunakaran Ramaswamy[1,3], MBBS, FRCA, MBA, Abbirami Sathappan[4] and Patrick Tang[5,6], MD, PhD, FRCPC

Abstract

Background: Opsite spray (Smith & Nephew) is often used prior to the application of epidural catheter dressing to reduce the risk of catheter dislodgment, improve adhesiveness of the dressing and for the perceived infection control benefits. However, the manufacturer and some end users have cautioned against its use on plastic devices as the spray may interact with the component constituents of the plastic, causing their deterioration, although such effect has not been evaluated previously.

Objective: The aim of the study is to investigate whether Opsite spray has any detrimental effect on epidural catheters including material degradation, loss of external markings and the possibility of bacterial contamination with multiple-use Opsite canisters.

Methods: Epidural catheters, of five different makes, were sprayed with Opsite spray in a laboratory environment. Thereafter, the catheters were examined physically and microscopically for any deterioration and were also subjected to pressure tests for potential leaks. In addition, Opsite spray containers in use in the hospital were assessed microbiologically for bacterial contamination.

Results: Loss of external markings on four catheters was noted once they were exposed to the spray. We found no evidence of structural degradation in epidural catheters exposed to Opsite spray after 72 hours, and we found no evidence of bacterial contamination of multi-use canisters.

Conclusion: Although Opsite spray did not cause any evident structural damage with the epidural catheters tested in our study, the loss of external markings is an attending risk. Depending on their composition, other catheter brands may interact differently when exposed to Opsite spray.

Keywords: Opsite spray, Plastic, Epidural catheters.

1 Department of Anesthesiology Sidra Medicine, Qatar.
2 University of East Anglia, United Kingdom.
3 Department of Anesthesiology, Weill Cornell Medical College, Qatar.
4 Deep Phenotype Core, Sidra Medicine, Qatar.
5 Department of Pathology, Sidra Medicine, Qatar.
6 Department of Pathology and Laboratory Medicine, Weill Cornell Medical College, Qatar.
* **Corresponding Author:** Niamat Aldamluji, MBChB, FRCA, FCAI, MSc, EDRA, DA. Attending Physician, Adult Anaesthesiology, Anaesthetic Department, HB-1C 404, Sidra Medicine, Doha, P.O. Box: 26999, Qatar. Phone: +974 40036466. E-mail: naldamluji@sidra.org

Introduction

Opsite spray is commonly used in clinical practice as it is believed to deposit a bacteria-proof plastic film on the surface preventing wound site infection while helping the affected area to heal. It can be used as a protection for minor surgical wounds, grazes, unbroken blisters and dry wounds. It is also used for sealing drainage tubes, vaccination sites, orthopaedic fixation and catheter fixation.[1] Furthermore, Opsite spray is sometimes used prior to the application of dressing to both epidural catheter and central vein cannulation sites.

Epidural catheter dislodgement, with certain fixation methods, can be significant as demonstrated by one retrospective audit to be up to 5% of all catheters.[2]

Historically, Opsite spray has been used to improve adhesiveness of the catheter and overlying gauze swabs to skin or to the transparent dressing. Bishton et al compared the use of three different labour analgesia epidural catheter fixation methods, all included the use of Opsite spray, and reported effectiveness of applying the spray with migration value of epidural catheters not significantly different between the three methods. They also reported that the incidence of clinical problems were not significantly different between patient groups, irrespective of the degree of catheter migration.[3]

A potential problem with its use, Opsite spray appears to dissolve the external catheter markings of some catheter brands. Having introduced Braun PerifixÒ One (B. Braun Medical Ltd., Melsungen, Germany) epidural catheter sets to an obstetric unit in the UK, it was noted that the black centimetre markings on the catheter were lost from the catheter after exposure to Opsite spray film dressing. This interaction, however, was not noticed to take place with other epidural catheters in common use.[4]

Examining the Opsite product insert (Smith & Nephew, Hull, UK)[1], it clearly states that it should not be used with "plastic" intravascular devices. The manufacturer of Opsite cannot, as indicated on their product information sheet, guarantee its safety without a full chemical breakdown of the device tubing.

The ethyl acetate and acetone in the spray can react with, and lead to degradation of the plastic in the device. However, we are aware from experience and by examining the literature, that the Opsite spray is being used with epidural catheters in clinical practice.[5,6] To date and to our knowledge, the effect of Opsite spray on epidural catheters has never been formally assessed. The other concern with Opsite use is the potential contaminant effect of the spray carried over through the canister's nozzle, as canisters are for multiple use and stored in variable conditions and for a variable length of time.

This is an observational study aimed to investigate the potentially detrimental effects of Opsite spray on all of the five epidural catheter brands available in our institution, namely degradation of the material of the catheter, loss of external markings and to find out, if any, contamination risks are associated with use of the Opsite spray.

Methods

Our Institutional Review Board granted this project an exemption for being a non-human subject study.

All brands of epidural catheters in use in our institution (Appendix 1) were exposed to Opsite spray by spraying them for 4 seconds, and then kept for a period of 72 hours at 37°C in an incubator. To determine the amount of Opsite to be applied to the catheter, we monitored, on 6 occasions, anesthetists using the spray and determined that the average time used, was 4 seconds of full stream spraying.

The catheters were cut into 5-centimetre portions, placed in a petri dish, sprayed with Opsite. There was enough spray liquid present in the petri dish to completely cover the catheter samples, hence catheters were left for another 4 seconds in the dish to ensure homogenous coating.

The cut catheters were then stored in an incubator at 37°C to mimic normal human body temperature for 72 hours.

In line with the industry quality inspection principles, we examined the catheters visually, microscopically and conducted pressure testing for material integrity.[7] The catheters were examined for any

Appendix 1
Epidural catheter brands used in this study

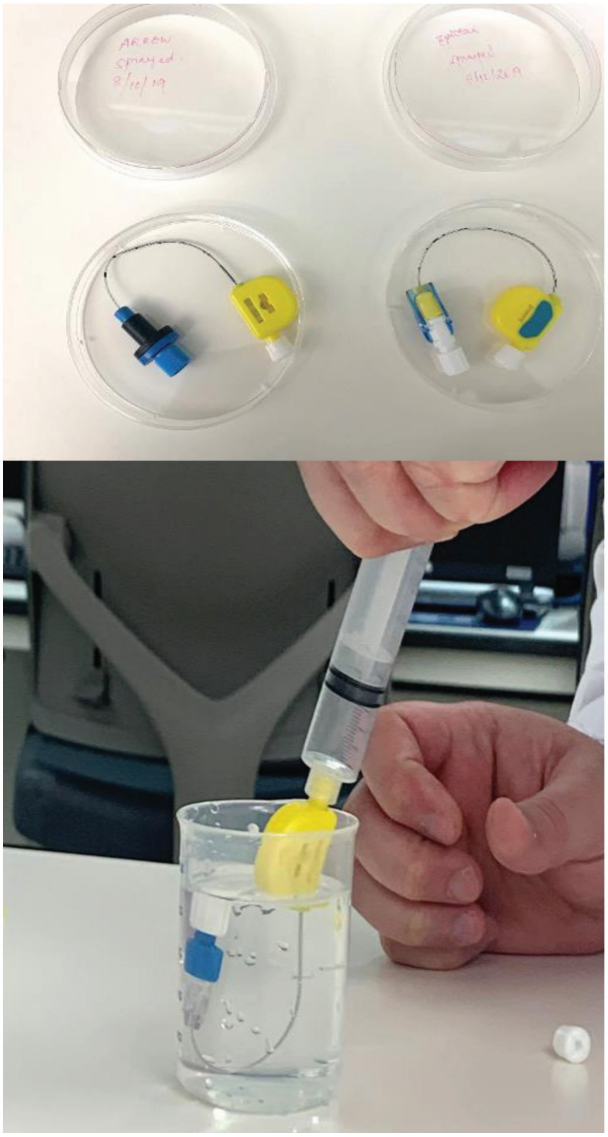
Catheter type	Manufacturer/ Notes
Arrow® Epidural set	Teleflex Grosvenor House Horseshoe Crescent Old Town Beaconsfield HP9 1LJ Phone: +44 (0)1494 53 27 61 Fax: +44 (0)1494 52 46 50 Link: https://www.teleflexarcatalog.com/anesthesia-respiratory/pain/product/ak-05502-flextip-plus-epidural-kits-and-sets Expiry date: 6/2020
EPISTAR CSE Maxi-Set	Teleflex Grosvenor House Horseshoe Crescent Old Town Beaconsfield HP9 1LJ Phone: +44 (0)1494 53 27 61 Fax: +44 (0)1494 52 46 50 Material: Polyamide Link: http://base.euro-pharmat.com/PDF/1101-39610-1.pdf Manufactured: 02/2017. Expiry date: 01/2022.
Pajunk EpiSpin lock	PAJUNK® MEDIZINTECHNOLOGIE GmbH Karl-Hall-Str.1 D-78187 Geisingen, Germany. Link: https://www.pajunk.eu/c3view.php?sid=8G33w33gwGjbYUfzwffetUI3lLhtIbUOwehbi3vw&ieb=1445411469&c3p=362&c3l=en Manufactured: 05/2017. Expiry date: 05/2022.
Perifix® ONE	B. Braun Melsungen AG Carl-Braun-Straße 1 34212 Melsungen, Hessen Germany Phone: +49 5661 710 Fax: +49 5661 714567 Material: polyamid/polyurethane Link: https://www.bbraun.com/en/products/b0/perifix-one-paedfiltersetswithlorsyringe.html Manufactured: 03/2017. Expiry date: 03/2021.
Portex®	1500 Eureka Park, Lower Pemberton, Ashford, Kent, TN25 4BF, UK Tel: +44 (0)845 850 0445 Fax: +44 (0)1233 722153 Email: ukcs@smiths-medical.com Link: https://m.smiths-medical.com/~/media/M/Smithsmedical_com/Files/Import%20Files/SM196419GB-0411_LR.pdf Manufactured: 06/2018. Expiry date: 06/2023.

deterioration by comparing the sprayed segment with a control, non-sprayed segment of the same catheter and testing the catheter for leaks by pressurising the system with air as well as with fluorescence.

Initial benchmarking studies were conducted in our lab on non-sprayed catheters. Catheter samples were subjected to scratches, grooves, and cuts and visualised in brightfield and phase contrast imaging in order to benchmark changes. Initial visual inspection of the sprayed Opsite catheter samples were also studied. The samples were subjected to Acridine orange, DAPI, propidium iodide, Blebbistatin and Fluorescein to determine the appropriate fluorescent stain. Having considered all different examination modalities available, we used brightfield physical examination, as it offers clarity over fluorescence imaging.

Systematic areas were chosen along the length of the tested catheters. The catheters were examined for scratches, cavities, grooves, pits or jagged spots on

Fig. 1
Leak test



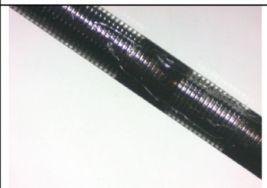
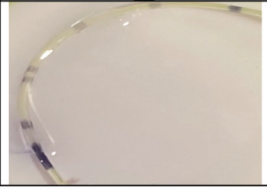
the surface. The geometry and precision of the catheter were examined under the brightfield microscope both in widefield and phase contrast modes. The tests were conducted on catheters placed on the inverted EVOS microscope at 4x and 10x magnification. Images of the catheters were taken before and after catheters were subjected to the Opsite spray. In addition to initial testing, four sets of visual and microscopic examination were done on all catheters sprayed and non-sprayed segments, at 1, 24, 48 and 72 hours from spraying.

Brightfield Images were acquired using Zeiss Lumar.V12 equipped with camera Axiocam Erc 5s. The stereoscope was used with a 1.2x objective and digital zoom of 10x, 20x, 60x and 100x to visualise finer details of the catheter.

Air leak tests were conducted on all catheters. These tests were performed as an addition to the microscopic inspection to further confirm whether there was an actual damage or not irrespective of the microscopic appearance. Although leak test with air carries high precision,[7] we carried out leak tests with both air and fluorescent fluid. The catheters were subjected to leak inspection tests, in water, after 72 hours of being sprayed with Opsite spray. The two ends of the cut catheters had Luer lock clamps attached as demonstrated in figure 1. A stopper applied to one of the clamps, while the other had a 10 ml syringe attached for pressurisation. When air or fluorescent fluid is pressurised through the catheter, any cuts along the length of the tube would be evident as the gas leaks out as bubbles or dye leaking out respectively.

Furthermore, the nozzles of two Opsite containers were swabbed prior to initial use, and after 7 days of daily use. The swab samples were each cultured on a

Fig. 2
Loss of surface markings.

Catheter	Gross appearance
Arrow	
Epistar	
Pajunk Epispin Lock	
Perifix	

blood agar plate at 37°C for 48 hours.

The following comparative indices of the sprayed and non-sprayed epidural catheter segments were recorded: physical damage including loss of surface markings, microscopic degradation, pressure testing and microbiological contaminant effect of the spray.

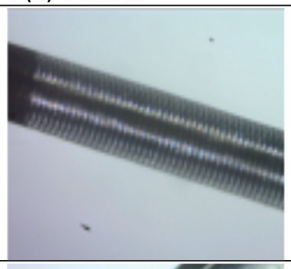
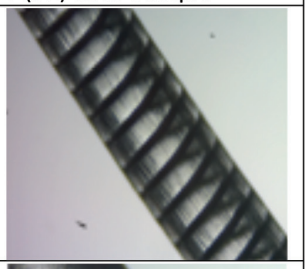
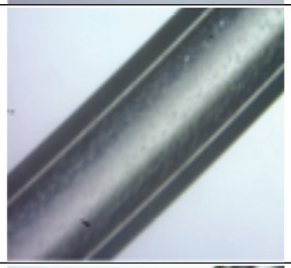
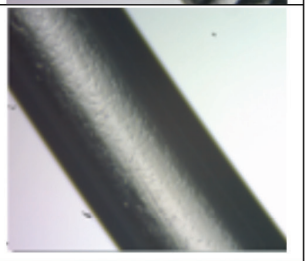
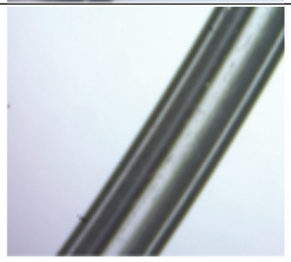
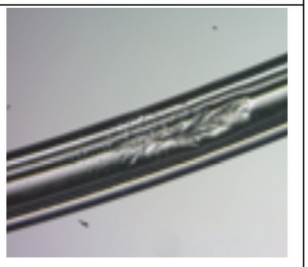
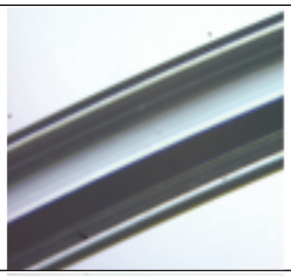
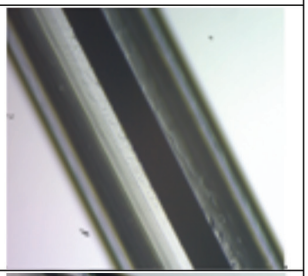
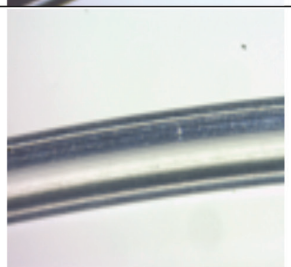
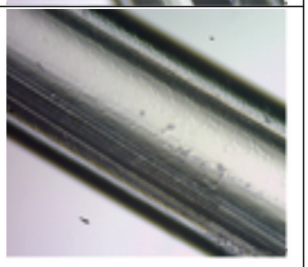
Results

Visual inspection

Catheter brands Arrow® Epidural set, EPISTAR CSE Maxi-Set, Pajunk EpiSpin lock and Perifix® ONE demonstrated loss of surface markings soon after being exposed to Opsite spray (Figure 2). Portex®

Fig. 3

Control and sprayed catheter images at t(0) and t(72) where deposits on Opsite spray is evident on all catheters.

Catheter	T (0) Control	T (72) hour Sample
Arrow®: Images of the control and sprayed Arrow sets demonstrated that the tubes are sturdy. The inner tubing reinforcement of the catheter remained unchanged with the spraying. No significant difference was observed in both the control and test samples.		
Epistar: Examination demonstrated deep grooves on the surface of the tube when imaged under the microscope. The grooves became more evident at high magnification. Grooves were observed in both the test sample as well as the controls, and they don't seem to be related to spraying the catheter.		
Pajunk EpiSpin Lock: Images looked clear and crisp when 1.5x low magnification was used. However, at higher magnification, several marks were noticed on the tubes in both the control and the test sample and this doesn't seem to be related to spraying the catheter. The sprayed tubes showed traces of sediments as well.		
Perifix®: Images of the Perifix tubes showed that the surfaces were smooth in controls as well as sprayed samples. No changes detected in the sprayed samples.		
Portex®: The images of both the test sample and the control catheters showed an uneven surface, with severe patterns when magnified. The clinical significance of this is unknown and they don't seem to be related to spraying the catheter.		

catheter had no gross changes to surface markings to the naked eye.

Microscopic examination

Details of microscopic examination are demonstrated in figure 3. All catheters' surface markings were examined under the microscope where the loss of the external dye was demonstrated in four catheter brands as shown in figure 2.

Air and fluorescence leak test

All 5 catheters, control and sprayed samples, had no bubbles detected along the length of the tube when air or fluorescence pressurised through the catheter via a 10ml syringe.

With the stopper removed and the open end of the catheter submerged in water, air was pushed in through the syringe without escape of air bubbles. Initially it was noted that air did not pass through the open ends as they were blocked by the Opsite spray getting into the lumen of the catheter as seen in figure 4. We therefore cut about 0.5 cm off the ends of the catheter and repeated the leak test. This time air bubbles/ fluorescence in the water were observed during pressurisation of the open-end catheters, and no leak was observed once the end was blocked by applying the lock and cap mechanism.

Microbiological assessment

Two Opsite canisters were swabbed for microbiological testing prior to initial use and after 7 days of daily use. No significant bacterial growth was detected on the nozzles of the new and used Opsite canisters after 48 hours of incubation.

Discussion

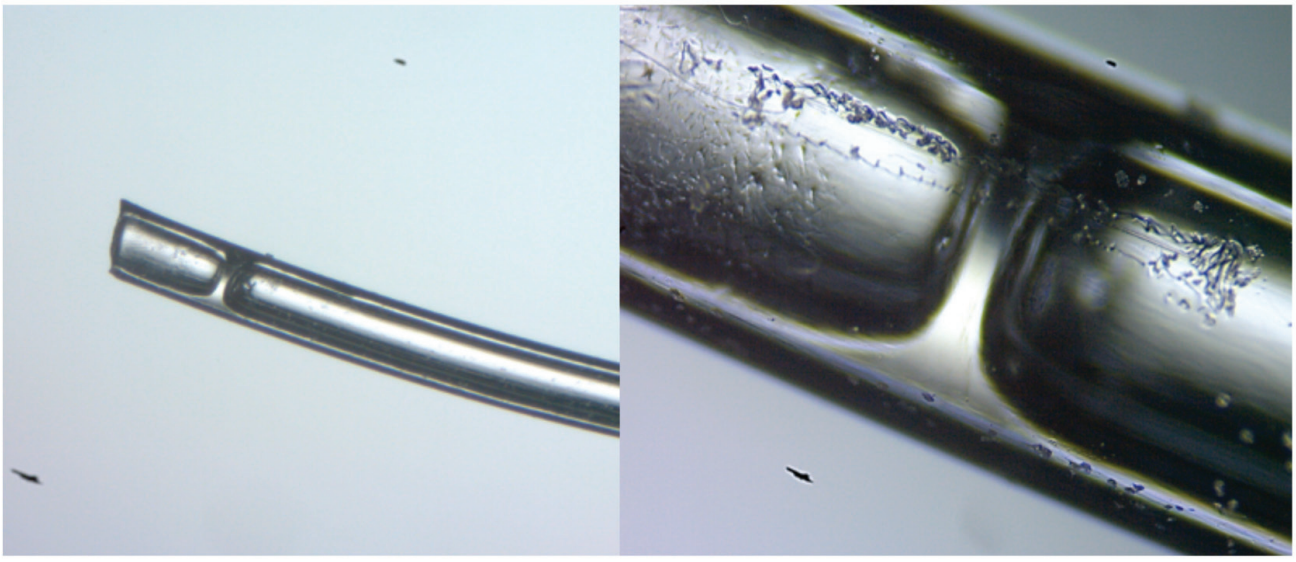
Similar to results shown by Moody et al.,[4] our study demonstrates the incompatibility of Opsite spray to B. Bbraun Perifix® ONE, the Arow® Epidural, the EPISTAR CSE Maxi-Set, and the Pajunk EpiSpin catheters.

Loss of surface markings once exposed to the spray is a significant observation. The marks serve as a guidance to the catheter depth at the skin on subsequent examination of the insertion site, after the spray is applied. It seems that the marks on the Portex® catheter is embedded or integrated into the catheter material and hence are less likely to be "washed" out when compared to the other catheter makes used in this study.

Opsite spray dressing (Smith & Nephew) according to its product safety datasheet is composed of approximately 98% solvents (table 1).[8 9] Generally speaking, plastics contain a wide range of substances

Fig. 4

Microscopic view: Catheter lumen occluded by the Opsite Spray.



and chemical products which have undergone polymerisation. The added polymers in the catheters are more likely to be dissolved by the solvents in the Opsite spray, that could then cause catheter degradation.[6]

Table 1

Opsite spray components

Chemical	Concentration
Acetone	30-60% v/v
Dimethyl ether	10-30%
Isopropyl alcohol	10-30%
n-Butane 40	10-30% v/v
Propane	5%
Ethyl acetate	<10% v/v
Isobutane	5%
Acrylic co-polymer (Confidential CAS registry number)	<10%

Our study did not find any basis to support the claim that the spray may degrade the plastic components of the tested epidural catheters. Instead, our results demonstrate either the potentially "sealant" effect of Opsite spray, which was not an expected outcome. This is possibly due to the polymerization of plastic contents of the spray along with the catheter plastic content when stored at 37 degrees Celsius.

Despite the potential risk of degrading plastic particles, premised on the fact that the Opsite spray constituents can react with and lead to degradation of the plastic in the device, Opsite components seem to form a stable clot over any open area as demonstrated by the observed blockage of the catheter ends.

Further studies are recommended to understand the exact interaction between the constituents of plastics in the catheter and the Opsite spray using mass spectroscopy.

Traditionally, material integrity is studied by using scanning electron microscope (SEM). We chose to use optical microscopic study evaluations as those do not disrupt the normal course of the material, as SEM and concomitant dye usage could potentially cause. Using SEM would not have allowed us to inspect the catheter further, however, it would have afforded us better resolution and smaller field of view of the material under inspection. Hence, the images of potential caused defects, if found, could be further improved by applying SEM imaging parallel to optical inspection of the catheter. The catheters were later tested for leaks, which adds to the credibility of the microscopic view confirming integrity of the catheters.

A limitation of the microbiological assessment is that the blood agar media is designed to detect common human pathogens, such as those causing wound infections. It is possible that the canister nozzle may be contaminated by environmental organisms which may not be readily detected by this method. However, the clinical significance of such organisms may be limited. Additionally, the solvents in the spray would likely inhibit the growth of any bacterial populations on the nozzle.

Conclusion

It is reasonable to conclude that Opsite spray did not cause structural damage with the tested epidural catheter brands; however, loss of surface markings is a considerable risk due the loss of catheter distance guidance and the unknown effect the dissolved dye can cause when deposited on the or underneath the skin surface. Furthermore, other brands may interact differently when exposed to the spray, depending on the components of the catheter in question.

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Conflicts of interest: All authors declare that there are no conflicts of interest.

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