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About the Presenter: Amanda Corley

Amanda is an intensive care nurse with 25 years experience and specialties in cardiac surgical and respiratory critical care. She is an Adjunct Research Fellow with AVATAR at Griffith University, and a Nurse Researcher at the Critical Care Research Group, The Prince Charles Hospital. Amanda has published >25 peer reviewed research articles and held several research grants. She is Masters prepared in research methods and commenced her PhD this year. Amanda has particular expertise and interest in the largest of all vascular access devices - ECMO (Extra Corporeal Membrane Oxygenation) cannulae, and is one of a small few of researchers globally in this area. She has also published research on the care of arterial and central venous catheters in the ICU.

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VAD failure is unacceptably high. Up to 50% fail before completion of necessary treatment.

Role of dressing & securement to prevent VAD failure

- Fully cover the wound
- Facilitate moisture vapour transmission
- Prevent or contain ooze
- Antimicrobial impregnation
- Barrier to microbial colonisation

Motion reduction
- Internal: micro-motion and pistoning within vessel
- External: maintain correct central vein position

- Minimise skin irritation
- Comfortable
- Easy to use
- Transparent
- Affordable

Patient, clinician and institutional factors

Tissue Adhesive

Medical grade Cyanoacrylate glue

N-Butyl Cyanoacrylate
- Strength
- Polymerises in 30sec
- Microbial barrier (gram positive bacteria)

2-Octyl Cyanoacrylate
- Strength
- More flexible than n-Butyl cyanoacrylate
- Microbial barrier (gram positive and negative)

N-Butyl + 2-Octyl Cyanoacrylate
- Improved elasticity plus strength
- Low polymerization temp (45°C)
- Breathable antimicrobial barrier (gram + and -)

Peripheral VADs: Evidence overview

Peripheral intravenous catheters (PIVs)  Peripheral arterial catheters (ACs)

Preliminary invitro testing

Cyanostylate tissue adhesives – effective seurement technique for intravascular catheters: in vitro testing of safety and feasibility


Preliminary work involved:
1. Testing removal solutions – Remove™, Paraffin, Acetone
2. Pull-out force of 4 seurement options (including TA – Dermabond & Histoacryl)
3. Antimicrobial properties of TA

Pull-out force to dislodge PIV

Assessment of tissue adhesives and removal agents for chemical compatibility with PIVs

<table>
<thead>
<tr>
<th>Removal agent</th>
<th>Tensile strength (N, mean±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove™</td>
<td>59.2±1.44</td>
</tr>
<tr>
<td>Paraffin</td>
<td>46.1±2.28</td>
</tr>
<tr>
<td>Acetone</td>
<td>24.9±1.99</td>
</tr>
</tbody>
</table>

Data expressed as mean±SD. The control was plain intravascular catheter (IVC) without use of any chemical agent. *P <0.05 control vs chemical agent.

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### Antimicrobial properties

<table>
<thead>
<tr>
<th>Bacterial growth surrounding IVCs and fixation devices*</th>
<th>18 hours</th>
<th>72 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry point? IVC tract beneath fixation device</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>NA</td>
</tr>
<tr>
<td>S. epidermidis</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dacron (a=4)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Steri-stick 1024 (a=4)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Steri-stick 1058 (a=4)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### TA application to PIV

![Image of TA application to PIV]

### TA removal from PIV

![Image of TA removal from PIV]

Randomised controlled trials in PIVs

1. PIVs in acute care adults (Marsh et al, 2015)
2. PIVs inserted in emergency department (Budgen et al, 2016)
3. PIVs in acute care adults (unpublished)

1. PIV in acute care adults (Pilot RCT)
   - 4 arm, non-blinded, single centre pilot RCT
   - Primary outcome: PIV failure
   - Compared:
     1. Tissue adhesive
     2. Standard transparent dressing
     3. Bordered transparent dressing
     4. Sutureless securement device

RESULTS
- n=85
- 5305 PIV hours
- 4 adverse skin events all in TA group
  - 1 skin tear
  - 2 rashes
  - 1 blister

Figure 1. Proportion of failures by device type

2. PIV inserted in emergency department

- 2 arm non-blinded RCT in metropolitan ED
- Primary outcome: PIV failure at 48 hours
- Compared:
  1. Tissue adhesive
  2. Bordered transparent dressing

2. PIV inserted in emergency department

**RESULTS**

- n = 369
- No adverse skin reactions
- Occasional feeling of ‘pulling’ noted during removal

<table>
<thead>
<tr>
<th></th>
<th>Standard Care, No. (%)</th>
<th>Skin Glue, No. (%)</th>
<th>Difference (95% CI), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVC failure</td>
<td>52 (27)</td>
<td>31 (17)</td>
<td>-10 (-18 to -2)</td>
</tr>
<tr>
<td>Secondary outcomes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infection</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Phlebitis</td>
<td>9 (5)</td>
<td>6 (3)</td>
<td>-1 (-5 to 3)</td>
</tr>
<tr>
<td>Occlusion</td>
<td>20 (11)</td>
<td>15 (8)</td>
<td>-5 (-8 to 4)</td>
</tr>
<tr>
<td>Dislodgement</td>
<td>26 (14)</td>
<td>13 (7)</td>
<td>-7 (-13 to 0)</td>
</tr>
</tbody>
</table>

CI, Confidence interval.

P = 0.02

3. PIVs in acute care adults (large RCT)

- 2 site, 4 arm, single blinded definitive RCT
- Primary outcome: PIV failure (dislodgement, occlusion, phlebitis, and primary bloodstream or local infection)
- Compared:
  1. Tissue adhesive and standard transparent dressing
  2. Simple transparent dressing
  3. Bordered transparent dressing
  4. Sutureless securement device and standard transparent dressing

### 3. IVs in acute care adults (large RCT)

**RESULTS**
- n=1697/ 115,408 IV hours
- Compared to control (SPU), TA group had:
  - significantly less occlusion (56 vs 79/1000 days, p=0.03)
  - less dislodgement (24 vs 35/1000 days, p=0.07)
  - Highest staff rating for acceptability and performance

### Updated Systematic Review:
Polyurethane (PU) vs Tissue Adhesive (TA) + Polyurethane

<table>
<thead>
<tr>
<th></th>
<th>PU</th>
<th>TA+PU</th>
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</thead>
<tbody>
<tr>
<td>3 RCTs</td>
<td>N=1081</td>
<td>N=632</td>
</tr>
<tr>
<td>Failure</td>
<td>38%</td>
<td>31%</td>
</tr>
</tbody>
</table>

7% reduction in IV failure
Relative Risk 0.86, P= 0.03

Securement of IVs requires further product and/or practice innovation

Randomised controlled trials in peripheral arterial catheters (ACs)

1. ACs in adult ICU (Edwards et al, 2014)

2. ACs inserted in adult operating theatre and maintained in ICU (Reynolds et al, 2015)

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TA application to AC

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1. ACs in adult cardiac and general ICU

- 4 arm, single centre, unblinded pilot RCT
- Primary outcome: AC failure (complete dislodgement, occlusion, pain or any infection)
- Compared:
  - 1. Tissue adhesive
  - 2. Bordered polyurethane dressing
  - 3. Sutureless securement device
  - 4. Standard polyurethane dressing

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A pilot trial of bordered polyurethane dressings, tissue adhesive and sutureless devices compared with standard polyurethane dressings for securing short-term arterial catheters

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1. ACs in adult cardiac and general ICU

<table>
<thead>
<tr>
<th>Results</th>
<th>SPU n=47</th>
<th>BPU+ SPU n=43</th>
<th>SSD + SPU n=49</th>
<th>TA + SPU n=56</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=195</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7147 AC hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient and staff satisfaction high in all groups</td>
<td>10 (21%)</td>
<td>2 (5%) *</td>
<td>8 (16%)</td>
<td>6 (11%)</td>
</tr>
<tr>
<td>Anecdotally, TA degraded over ~ 3 days</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dressing costs</td>
<td>$3.48</td>
<td>$5.07*</td>
<td>$10.90*</td>
<td>$17.70*</td>
</tr>
</tbody>
</table>

SPU - Standard polyurethane dressing; BPU - Bordered polyurethane dressing; SSD - Sutureless securement device; TA - Tissue adhesive
* p<0.05 when compared with control (SPU)

2. ACs in adult OT and general ICU

- 4 arm, single centre, unblinded pilot RCT
- Primary outcome: AC failure (complete dislodgement, occlusion, phlebitis or any infection)
- Compared:
  1. Tissue adhesive
  2. Bordered polyurethane dressing
  3. Sutureless securement device
  4. Standard polyurethane dressing

2. ACs in adult OT and general ICU

Results
- n=195
- 7147 AC hours
- 14% reduction in failure with TA when compared with control (SPU)
- Patient satisfaction highest in TA group

SPU - Standard polyurethane dressing; BPU - Bordered polyurethane dressing; SSD - Sutureless securement device; TA - Tissue adhesive

Meta-analysis: Polyurethane (PU) vs Tissue Adhesive (TA)

<table>
<thead>
<tr>
<th></th>
<th>PU</th>
<th>TA+PU</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 RCTs</td>
<td>n=77</td>
<td>n=88</td>
</tr>
<tr>
<td>AC Failure</td>
<td>21%</td>
<td>9%</td>
</tr>
</tbody>
</table>

12% reduction in AC failure
Relative Risk 0.43, P= 0.04

Take home message for TA use in PIVs and ACs

- Peripheral venous catheters: 7% reduction in failure compared to standard polyurethane dressing
- Arterial catheters: 12% reduction in failure compared to standard polyurethane dressing
- Adverse skin events: Requires further investigation to ensure appropriate patient selection

Central VADs (CVADs): Evidence overview

- Peripherally inserted central catheters (PICCs)
- Non-tunnelled CVADs
- Tunneled CVAD

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Randomised controlled trials in CVADs

1. PICCs in acute care adults (unpublished)
2. PICCs in paediatrics (Kleidon et al, 2017)
3. Jugular non-tunnelled CVAD in adult post-cardiac surgery patients (Rickard et al, 2016)
4. Non-tunnelled CVAD in paediatric ICU (unpublished)
5. Tunnelled CVAD in paediatrics (Ullman et al, 2017)

Application of TA to PICC

1. PICCs in acute care adults

- 4 arm, single centre, single blinded pilot RCT
- Primary outcome: PICC failure (infection, dislodgement, occlusion, and/or catheter fracture)
- Compared:
  1. Standard polyurethane dressing + Sutureless securement device + CHG disc
  2. Polyurethane with Absorbent Lattice pad dressing + CHG disc
  3. Combination Securement-Dressing (Sorbaview™) + CHG disc
  4. Tissue Adhesive + Standard polyurethane dressing

1. PICCs in acute care adults

| Results                                                                 | Sample Size | Failure Rate (%) | Incident rate/1000 cath days | Skin events* (%) |
|                                                                       | n=121       |                 |                              |                 |
| 1132 PICC days                                                        |             |                 |                              |                 |
| PAL group – ceased recruitment due to safety concerns                 |             |                 |                               |                 |
| High incidence of adverse skin events in all groups                   |             |                 |                               |                 |
| Standard polyurethane + Sutureless securement + CHG disc              | 39          | 4 (10%)          | 9                             | 12 (30%)        |
| Integrated Securement-Dressing + CHG disc                             | 42          | 3 (7%)           | 9                             | 10 (23%)        |
| Tissue Adhesive + Standard polyurethane                               | 35          | 3 (8%)           | 10                            | 13 (36%)        |
| Polyurethane absorbent lattice dressing + CHG                         | 5           | 1 (20%)          | 17                            | 1 (20%)         |

*any of rash, blister, itchiness, skin tear and bruising at device removal

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Lessons learned from this trial
- Positive feedback by clinicians regarding TA to control haemostasis (but not formally tested)
- TA easily removed from skin but built up++ on PICC, threatening skin injury
- Manual removal of TA from PICCs risked dislodgement, and was time consuming
- TA has potential benefits at insertion, its use for repeated dressings during PICC dwell was not feasible

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2. PICCs in paediatrics

- 3 arm, single centre RCT
- Primary outcome: PICC failure (cessation of function prior to completion of therapy)
- Compared:
  1. Bordered polyurethane dressing + sutureless securement device
  2. Integrated securement dressing
  3. Tissue adhesive + bordered polyurethane dressing

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2. PICCs in paediatric ICU

**Results**

- n=95
- Low overall failure rate (5%)
- Cost of TA higher but fewer dressing changes

<table>
<thead>
<tr>
<th></th>
<th>BPU + SSD n=32</th>
<th>ISD n=31</th>
<th>TA + BPU n=32</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICC failure</td>
<td>2 (6%)</td>
<td>2 (6%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>Incident rate/1000 catheter days</td>
<td>8</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Adverse skin events*</td>
<td>5 (16%)</td>
<td>3 (10%)</td>
<td>10 (31%)</td>
</tr>
<tr>
<td>Parental satisfaction (0-10)</td>
<td>7.6</td>
<td>9.7</td>
<td>8.5</td>
</tr>
</tbody>
</table>

*Itchiness, rash, skin tear, blister or bruising at any time during study

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2. PICCs in paediatric ICU

**Lessons learned from this trial**

- **Excessive application** of TA on insertion may lead to skin tears
- **Less is more** → 2 drops at insertion site and 2 drops to securement wings
- TA was removed easily from skin but difficult to remove from PICC resulting in **residual build up** → maybe not a long-term securement option
- TA could be useful as an **adjunct to other dressings**, to provide immediate haemostasis, reduce post-operative bleeding, and the need for early dressing change

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TA application to jugular CVL

3. Jugular non-tunelled CVAD in adult cardiac ICU

- 4 arm single centre pilot RCT
- Primary outcome: CVAD failure
- Compared:
  1. Bordered polyurethane + suture (control)
  2. Absorbent dressing + suture
  3. Sutureless securement device x 2 + standard polyurethane dressing
  4. #1 Tissue adhesive + standard polyurethane dressing
  5. #2 Tissue adhesive + standard polyurethane dressing + suture

Results
- n=221
- 15 479 CVAD hours
- TA without a suture in jugular CVADs was unsafe
- TA - Less patient and staff satisfaction, and more pain on removal

3. Non-tunelled jugular CVAD in adult cardiac ICU

Lessons learned from this trial

- Factors likely to be associated with TA failure:
  - Diaphoretic coagulopathic post-cardiac surgical patients
  - CVAD position (internal jugular vein)
  - Early mobilisation
  - ‘Drag’ from multiple infusions
  - Beard regrowth in males
4. Non-tunnelled CVAD in paediatric ICU

• 3 arm, single centre pilot RCT
• Primary outcome: CVAD failure
• Compared:
  1. Bordered polyurethane dressing + sutures + CHG disc (control)
  2. Tissue adhesive + control
  3. Integrated dressing securement + sutures + CHG disc

4. Non-tunnelled CVAD in paediatric ICU

Results
• n=180
• Similar levels of acceptability for each group
• TA most difficult to apply

<table>
<thead>
<tr>
<th></th>
<th>BPU+suture +CHG (control) n=54</th>
<th>ISD+suture +CHG n=56</th>
<th>TA control n=59</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVAD failure</td>
<td>3 (6%)</td>
<td>1 (2%)</td>
<td>6 (10%)</td>
</tr>
<tr>
<td>Non-routine dressing change</td>
<td>28%</td>
<td>13%</td>
<td>10%</td>
</tr>
</tbody>
</table>

5. Tunnelled CVAD in paediatrics

• 4 arm, 2 centre pilot RCT
• Primary outcome: CVAD failure
• Compared:
  1. Bordered polyurethane dressing + suture
  2. Sutureless securement device + suture + bordered polyurethane dressing
  3. Tissue adhesive (at exit wound and under catheter bifurcation) + bordered polyurethane dressing
  4. Integrated securement-dressing + suture
5. Tunnelled CVAD in paediatric ICU

**Results**
- n=48
- High staff approval on application
- High parental satisfaction on removal but not staff satisfaction

<table>
<thead>
<tr>
<th></th>
<th>ISD+ suture n=12</th>
<th>SSD+suture +BPU n=13</th>
<th>BPU+suture (control) n=11</th>
<th>TA+BPU n=12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVAD failure</td>
<td>2 (17%)</td>
<td>1 (8%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Adverse skin event*</td>
<td>2 (17%)</td>
<td>1 (8%)</td>
<td>2 (18%)</td>
<td>0</td>
</tr>
</tbody>
</table>

* rash, blister, itchiness

Non-randomised reports in CVADs

**Practice review of >30 CVCs** (Wilkinson et al, 2007)
- Application less time-consuming than sutures & line securement a ‘complete success’

**Practice review in 20 non-tunnelled CVCs** (Lawrence & Hacking, 2014)
- Application process easier than sutures
- But 3 CVC accidental removals; 6 CVCs ineffectively secured → TA NOT ADOPTED

Non-randomised reports in CVADs

**Cohort study of CVADs in adult patients** (Scoppettuolo et al 2013)
- In 45 PICCs, 11 dialysis catheters and 9 CVCs, no bleeding at 1 or 24 hrs post-insertion
- No adverse events/No damage to polyurethane catheters detected

**Cohort study of CVADs in adult & paediatrics** (Pittrelli 2016)
- 348 PICCs; 165 CVCs; 114 tunneled PICCs & CVCs; 802 ports & PICC ports
- 100% effective in haemostasis; in PICCs, in preventing extra-luminal bacterial contamination; and, in paediatric CVCs, achieved a tenfold reduction in CLABSIs

Non-randomised reports in CVADs

Cohort study of CVADs (and midlines) in adult patients (Ariotti 2016)
- >200 patients had TA applied to insertion site immediately after insertion, then compression bandage applied
- No need for dressing change within 24 hrs of catheter insertion
- Economic savings for hospital; and reduced discomfort for patient

Take home message for TA use in CVADs

PICCs
- TA reduced failure rates
- Build-up of TA over repeated applications was problematic

CVADs
- In non tunnelled CVADs, TA ± suture may be effective in preventing failure → more evidence required
- In tunnelled CVADs, TA appears to be effective in reducing CVAD failure and providing haemostasis

Adverse events
- Adverse skin events need to be investigated further
- Patient/device factors need to be considered

Clinical practice guidelines

‘Use of cyanoacrylate products (“super glue”) to prevent oozing or discharge from the exit site or to secure catheters was rated as neutral by the panelists, who noted lack of substantial evidence or experience to support this recommendation’
**Challenge for manufacturers**

- To supply TA in a form suitable for VAD securement
  - Smaller volume at a lower price point
  - More suitable applicators for VAD securement
  - VAD manufacturers could provide vials prepacked with insertion pack

**Where to now?**

- More large RCTs investigating TA use in all VADs are necessary, particularly:
  - PIV securement in paediatrics
  - PICC securement in all populations
  - Tunnelled and non-tunnelled CVADs in all populations
  - Testing of haemostatic and antimicrobial properties
- Adverse skin events associated with TA need to be explored further

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<thead>
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