# Prevention of Neonatal Extravasation Injuries: The Experience of a Neonatal Unit in Hong Kong

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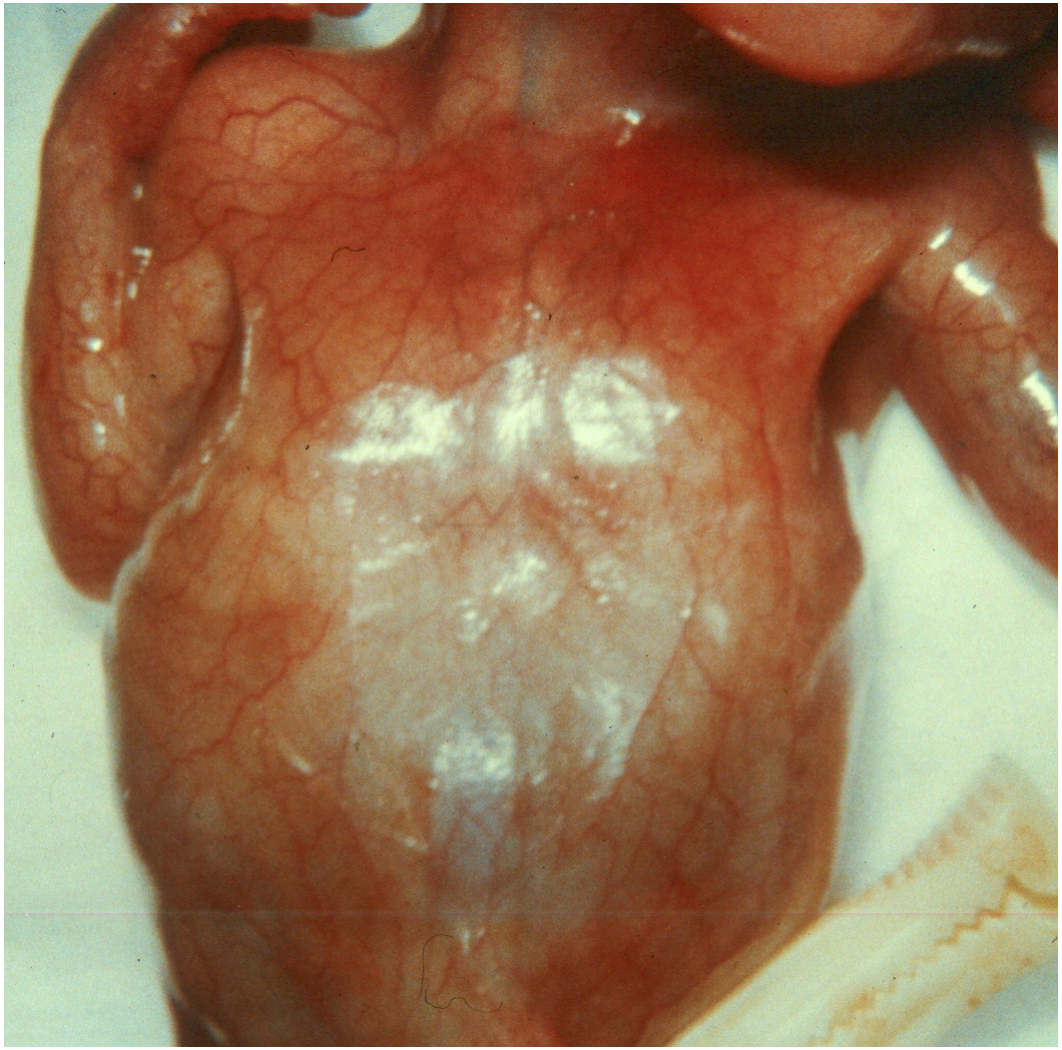
# Extravasation Injuries

An **iatrogenic** Complication

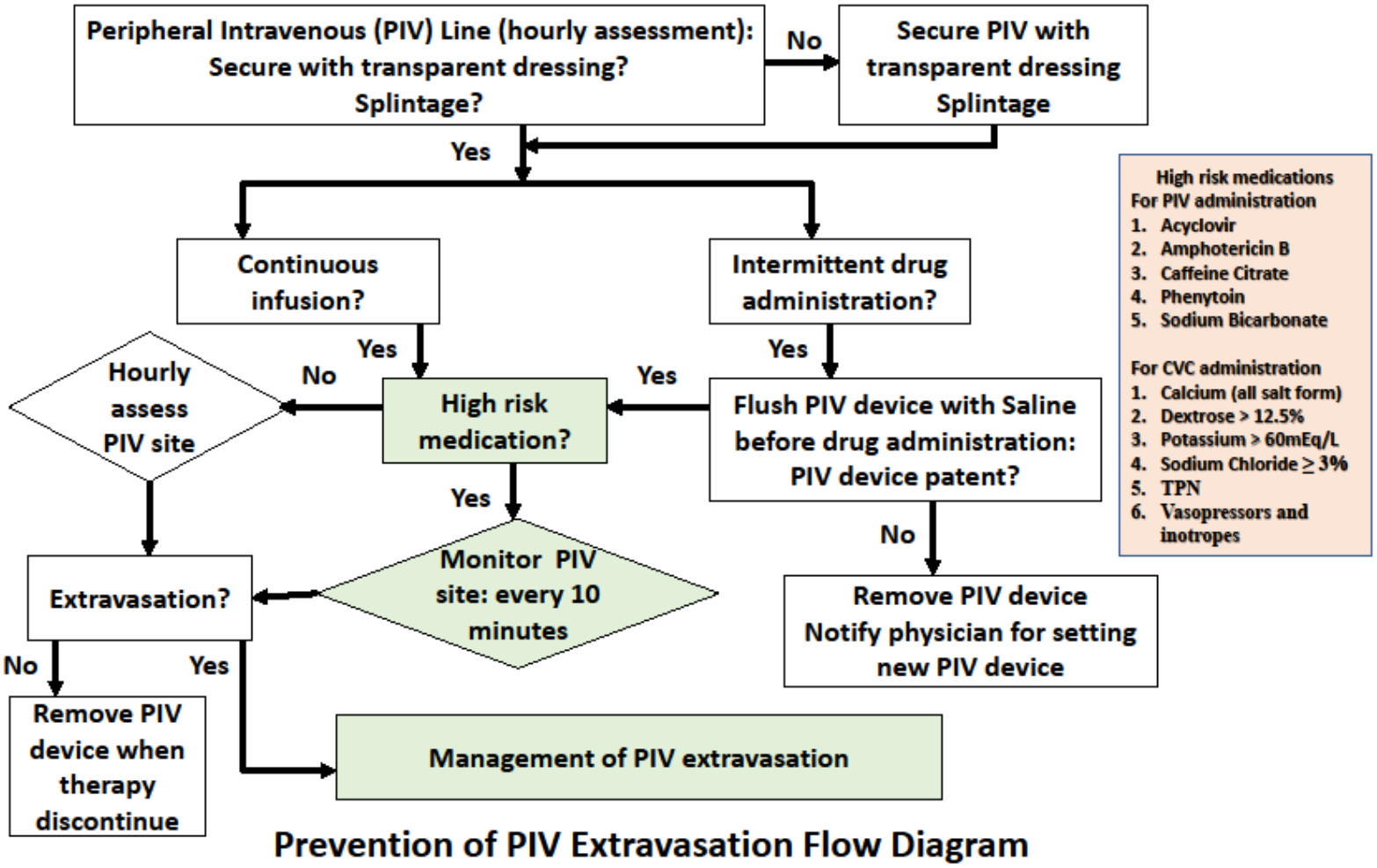
(Ming Pao, 2016)

# Neonatal Extravasation Injuries



# The Consequence

# The Clinical Practice Guideline




Prevention of PIV Extravasation Flow Diagram

# Key Changes

1. Assessment
   - Look, Touch, Compare
   - Size of contralateral extremity
2. Identification of high-risk medication
   a. Determine method of administration
   - Central venous Vs Peripheral intravenous

   b. Determine frequency of assessment
   - Hourly assessment Vs every 10 minutes

# Infiltration Scale

**Grade 0**

No symptoms

Flushes with ease

**Grade 1**

Localized swelling (1% to 10%)

Flushes with difficulty

Pain at site

**Grade 2**

Slight swelling at site:

(10% to 25% of the extremity above or below site)

Presence of redness

Pain at site

**Grade 3**

Moderate swelling at site:

(25% to 50% of the extremity above or below site)

Pain at site

Skin cool to touch

Blanching

Diminished pulse below site

**Grade 4**

Severe swelling at site (> 50% of the extremity above or below site)

Infiltration of blood products, irritants, and/or vesicants (any amount of swelling)

Skin cool to touch

Blanching

Skin breakdown / necrosis

Blistering

Diminished or absent pulse

Pain at site

Capillary refill > 4 seconds

**Pop (2012)**

# Management of Neonatal PIV Extravasation Flow Diagram

**Neonatal PIV Extravasation**

1. Stop infusion
2. Remove cannula
3. Determine grade of extravasation

**Extravasation: Grade 1 & 2**

1. Elevate affected limb
2. Observe circulation Q1H
3. Document for progress

**Extravasation: Grade 3 & 4**

1. Notify attending physician
2. Extravasation not cause by vasopressor: subcutaneous Hyaluronidase injection by physician
3. Extravasation cause by vasopressor: administer Phentolamine by physician
4. Elevate affected limb
5. Observe circulation Q1H
6. Pain management
7. Determine if skin is intact

**Intact Skin**

1. Observe extravasated site Q1H for 12 hour
2. Document for progress
3. Consult wound nurse if skin breakdown
4. Report & update progress to family
5. Incident reporting

**Skin: Not Intact**

1. Consult wound nurse for wound management if necessary
2. Document for progress
3. Consult plastic surgeon if necessary
4. Report & update progress to family
5. Incident reporting

## Infiltration Scale

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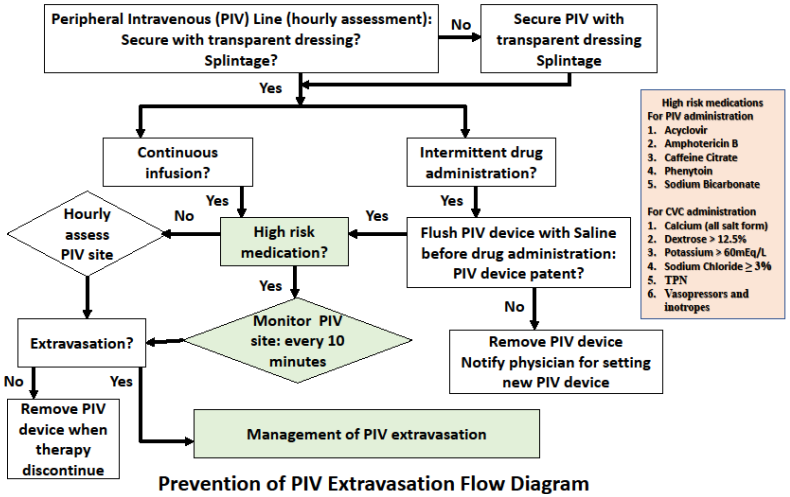
Infiltration of blood products, irritants, and/or vesicants (any amount of swelling)
Skin cool to touch
Blanching
Skin breakdown / necrosis
Blistering
Diminished or absent pulse
Pain at site
Capillary refill > 4 seconds

**Pop (2012)**

# Implementation

- Didactic training
- Video
- Cue cards
  - High-risk medication
  - Pediatric PIV infiltration scale
  - Flow diagram of clinical practice guideline
- Daily nursing round




Prevention of PIV Extravasation Flow Diagram

**Pediatric PIV Infiltration Scale**

| Grade | Characteristics |
|---|---|
| 0 | No symptoms<br>Flushes with ease |
| 1 | Localized swelling (1%-10%)<br>Flushes with difficulty<br>Pain at site |
| 2 | Slight swelling at site (up to ¼ of the extremity above or below site, or 10%-25% of the extremity above or below site)<br>Presence of redness<br>Pain at the site |
| 3 | Moderate swelling at site ( ¼ to ½ of the extremity above or below site, or 25%-50% of the extremity above or below site)<br>Pain at site<br>Skin cool to touch<br>Blanching<br>Diminished pulse below site |
| 4 | Severe swelling at site (more than ½ of extremity above or below site, or more than 50% of the extremity above or below site)<br>Infiltration of blood products, irritants, and/or vesicants (any amount of swelling)<br>Skin cool to touch<br>Blanching<br>Skin breakdown/necrosis<br>Blistering<br>Diminished or absent pulse<br>Pain at site<br>Capillary refill > 4 seconds |

# Evaluation

- Reduction of neonatal extravasation injuries
- Compare rate of neonatal extravasation injuries:
  - Pre-intervention Vs Post-intervention
    - Pre-intervention: collected over a period of 143 days
    - Post intervention: collected over a period of 143 days
  - Recruit neonate participants:
    - By convenience sampling

# Pre-intervention: Rate of Extravasation Injuries

| Characteristics of Neonates (Control Group) | | Frequency (Percentage) |
|---|---|---|
| Level of care | Special care baby unit (SCBU)<br>Neonatal intensive care unit (NICU) | 62 (59.6%)<br>42 (40.4%) |
| Sex | Male<br>Female | 59 (56.7%)<br>45 (43.3%) |
| Maturity | Full term<br>Pre term | 64 (61.5%)<br>40 (38.5%) |
| | Mean ± Standard Deviation | |
| SNAPPE 2 score | 20.86 ± 22.76 | |
| APGAR score: 1 minute | 8.82 ± 1.82 | |
| APGAR score: 5 minute | 8.89 ± 1.43 | |
| Gestational age (week) | 36.8 ± 4.31 | |
| Birth weight (gram) | 2587.07 ± 950.58 | |

Total number of participants in 'Control Group': 104 neonates

# Pre-intervention: Rate of Extravasation Injuries

1. **Peripheral intravenous catheter**
   a) **Number in-situ: 300**
   b) **PIV days: 855**
   c) **Number of extravasation: 12**
   d) **Rate of extravasation injuries per 1,000 PIV catheter days:**

**12 /855 x 1,000 = 14.035 per 1,000 catheter day**

# Post-intervention: Rate of Extravasation Injuries

| Characteristics of Neonates (Intervention Group) | | Frequency (Percentage) |
|---|---|---|
| Level of care | Special care baby unit (SCBU)<br>Neonatal intensive care unit (NICU) | 65 (59.6%)<br>44 (40.4%) |
| Sex | Male<br>Female | 56 (51.4%)<br>53 (48.6%) |
| Maturity | Full term<br>Pre term | 65 (59.6%)<br>44 (40.4%) |
| | Mean ± Standard Deviation | |
| SNAPPE 2 score | 21.93 ± 17.71 | |
| APGAR score: 1 minute | 8.6 ± 1.81 | |
| APGAR score: 5 minute | 8.96 ± 1.12 | |
| Gestational age (week) | 36.47 ± 4.65 | |
| Birth weight (gram) | 2528.11 ± 918.1 | |

Total number of participants in 'Intervention Group': 109 neonates

# Post-intervention: Rate of Extravasation Injuries

1. **Peripheral intravenous catheter**
   a) **Number in-situ: 312**
   b) **PIV days: 1033**
   c) **Number of extravasation: 3**
   d) **Rate of extravasation injuries per 1,000 PIV catheter days:**

**3/1033 x 1,000 = 2.9 per 1,000 catheter day**

# Homogeneity of Study Groups

| Characteristics of Neonatal participants | | Control Group (*N* = 104) Frequency (percent) | Intervention Group (*N* = 109) Frequency (percent) | $\chi^2$ *P* value |
|---|---|---|---|---|
| Gender | Female<br>Male | 45 (43.3%)<br>59 (56.7%) | 53 (48.6%)<br>56 (51.4%) | 0.433 |
| Level of care | SCBU<br>NICU | 62 (59.6%)<br>42 ( 40.4%) | 65 (59.6%)<br>44 (40.4%) | 0.998 |
| Maturity | Full term<br>Preterm | 64 (61.5%)<br>40 (38.5%) | 65 (59.6%)<br>44 (40.4%) | 0.776 |
| Mode of delivery | Spontaneous vaginal<br>Cesarean section<br>Vacuum extraction<br>Assisted breech | 47 (45.2%)<br>40 (38.5%)<br>16 (15.4%)<br>1 (0.90%) | 40 (36.7%)<br>47 (43.1%)<br>20 (18.3%)<br>2 (1.90%) | 0.618 |
| Vesicant administration | Yes<br>No | 11 (10.6%)<br>93 (89.4%) | 17 (15.6%)<br>92 (84.4%) | 0.278 |
| Types of IV line in situ | PIV only<br>PIV and central line | 78 (75%)<br>26 (25%) | 78 (71.6%)<br>31 (28.4%) | 0.571 |

# Homogeneity of Study Groups

| Characteristics of Neonatal participants | Control Group (*N* = 104) Mean ± Standard Deviation | Intervention Group (*N* = 109) Mean ± Standard Deviation | *P* value | Statistical test |
|---|---|---|---|---|
| Birth weight (gram) | 2587.07 ± 950.58 | 2528.11 ± 918.1 | 0.646 | Independent *t*-test |
| Gestational age (week) | 36.8 ± 4.31 | 36.47 ± 4.65 | 0.687 | Independent *t*-test |
| SNAPPE 2 score[#] | 20.86 ± 22.76 | 21.93 ± 17.71 | 0.527 | Independent *t*-test |
| APGAR score (1 minute) | 8.82 ± 1.82 | 8.6 ± 1.81 | 0.398 | Independent *t*-test |
| APGAR score (5 minute) | 8.89 ± 1.43 | 8.96 ± 1.12 | 0.842 | Independent *t*-test |
| Number of PIV | 2.88 ± 2.85 | 2.86 ± 2.96 | 0.854 | Independent *t*-test |
| PIV days | 8.22 ± 8.761 | 9.48 ± 8.785 | 0.022 | Independent *t*-test |
| Number of PIV extravasation | 0.1304 ± 0.3443 | 0.0345 ± 0.1857 | 0.012 | Mann-Whitney |

[#] NICU patients only

# Homogeneity of Study Groups

| Characteristics of Neonatal participants | | Pre-intervention (*N* = 104) Frequency (percent) | Post-intervention (*N* = 109) Frequency (percent) | $\chi^2$ *P* value |
|---|---|---|---|---|
| Subjects with PIV extravasation | Yes<br>No | 12 (11.5%)<br>92 (88.5%) | 3 (2.8%)<br>106 (97.2%) | 0.012 |
| Severity of PIV extravasation | Grade 0 or 1<br>Grade 2<br>Grade 3<br>Grade 4 | 92 (88.5%)<br>6 (5.8%)<br>4 (3.8%)<br>2 (1.9%) | 106 (97.2%)<br>3 (2.8%)<br>0<br>0 | 0.066 |

# Rate of Peripheral Intravenous Extravasation Injuries

- **Pre-intervention:**
  - 14.04 per 1,000 peripheral intravenous catheter days
- **Post-intervention:**
  - 2.904 per 1,000 peripheral intravenous catheter days
- **Logistic regression:**
  - Adjusted odds ratio in post-intervention period:
  - 0.2 (95% CI 0.05-0.74; *p*=0.016)
- **Benchmark with international children's hospital:**
  - Rate ranged from 3.4 to 7.1 per 1,000 catheter days

(Major & Huey, 2016; Tofani et al., 2012)

# Conclusion

**Compare to control group, there is a significant reduction of rate of neonatal extravasation injuries after implementation of the CPG**

**Rate of extravasation injuries: comparable with international children's hospitals**

**Multidisciplinary collaboration: Key to mitigate the risk**

# Thank You