Improving Free Flap monitoring and outcomes:

The FREE FLAP OBSERVATION (FLO) SCORING CHART

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Introduction

Free flap failure rates decrease with reduced time to exploration from evidence of vascular compromise[1]. Thus the quality of free flap monitoring and escalation post operatively influences flap survival.

Over the past decade there have been a range of new method to monitor flaps including flow couplers, implantable dopplers, laser doppler flowmetry, thermographic imaging and continuous transcutaneous near-infrared tissue oximetry[2] . Nonetheless, in many centres these have yet to be sufficiently refined, value tested or given financial and clinical backing. Thus the most common free flap monitoring tool remains serial clinical examination. Monitoring is generally performed by specialist nursing staff, with regular or as required clinician reviews depending on flap health.

At the tertiary Plastic Surgical centre in Liverpool we found our free flap failure rates where above the literature average when examining our past 5 year trends. Although many factors are at play when considering free flap failure rates; we sort to improve the role of free flap monitoring and communication between nurses and doctors.

Free flap health needs to be considered on a local and systemic level as good systemic perfusion is a prerequisite for good perfusion of the flap. Pulse rate, blood pressure and urine output will all aid in assessment of the well hydrated, well perfused patient, and thus these measurements are included on the FLO score chart, with trigger system designed to optimise systemic perfusion. Flap perfusion otherwise relates to venous outflow and arterial inflow and these can be assessed using flap colour, warmth, capillary refill and doppler signals [3]. These clinical signs are recorded on the FLO chart, again with a trigger system to alert doctors to any change involving any of these local flap parameters. There are flaps in which these clinical assessment are more challenging, such as muscle flaps, or flaps without a superficial aspect or paddle. It is recommended that an adjunct monitoring device is used for these flaps where clinical assessment alone is challenging.

Intervention

A nurse lead flap observation chart was devised with a trigger system to alert doctors to a failing flap: The **FLO** score chart

FREE FLAP/ REPLANT OBSERVATION (FLO) SCORING CHART

Place Sticker	
Name	
DOB	
Hospital No	

Ward: .....

Consultant: .....

Date of Operation: .....

Procedure.....

Post-Operative Instructions

.....

.....

Observation Frequency Required:

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FLAP OBSERVATION (FLO) SCORING CHART
Keywords: Temp: **w**arm/cold. Colour: **p**ink or **p**erfused, **w**hite, **b**ruised
If 1 – optimise hydration status. Call SHO if concerned
If 2 – Immediate call SHO/SpR

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Sig	Date	Time	Flap				Physiology			FLO Score Total:
			Temp w/c	Colour p/w/b	CR 1/2/3/4 /4+	Doppler 1✓2✓3✘	Systolic BP	HR	Urine Output	
	FLO Score Calculation:		*c=2*	*w/b=2*	*1/4/4+ =2*	*✘ =2*	*<90 S = 1*	*>110 = 1*	*<30ml/hr = 1*	
L	18/9	9	W	P	2	1 ✓	90	112	45	1

Aims

1. To aid early detection of failing flaps.
2. To improve communication between nurses and doctors regarding failing flaps
3. To decrease time to return to theatre for failing flaps
4. To reduce flap failure rates

The FLO chart was introduced to the specialist plastic surgical nurses and recovery nurses though a series of teaching sessions Sep 2018.

Methods

A retrospective collection of free flap data over the time period of intervention Sep 2018 – Feb 2019 (6 months) was undertaken.
Time of 1st concern was recorded as per notes and on FLO chart.
FLO score and time to action post concern was recorded (theatre or other intervention).

Results

Trauma Flaps

8 patients, with 8 free flaps were performed in the study period.
Age range – 21-64. 1 case suffered partial loss (skin paddle only), all other flaps survived. 4 flaps required return to theatre (50%).

Breast Reconstruction flaps

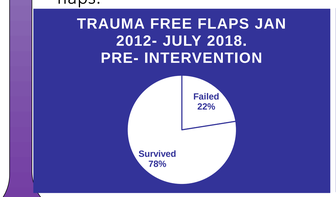
69 patients in the study period. 2 flaps suffered partial loss, no complete losses. 3 flaps required return to theatre for flap issue (4.3%)

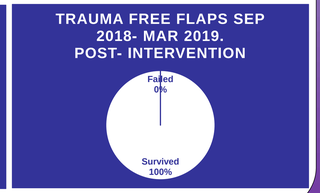
FLO results

The FLO chart detected change and triggered a doctor review in 6/7 flaps that required return to theatre. The one flap where the FLO did not detected change, was a flap that returned to theatre after a short 30min stay in resus and the FLO chart had not be instigated.

The FLO scoring system did trigger reviews but was not always correctly assigned. T= trauma flap. B= breast recon flap.
T1: 64 Free Fibula to ulnar. **Score 2**
T2: 26F ALT to open tibia/fibula fracture. **Score 4**
T3: MSAP to right Foot **Score 2**
T4 21F ALT to left foot **Score 1** (incorrect)
B1 –
B2: R DIEP. **Score 2**
B3: R DIEP. **Score 1** (incorrect)
Score correctly assigned 71% of time

A FLO score change triggered a rapid response in 5/6 failing flaps
T 1: **0mins** FLO – Doctor review
T 2: **3hrs** to theatre
T 3: **1hr** to theatre
T 4: **0mins** FLO- Doctor review
BR 2: **15mins** FLO – Doctor review
BR 3: **2.30hrs** FLO – Doctor review
Average FLO – Doctor review 41mins
The average time for a failing flap to return to theatre in the study period was 2 hours for trauma flaps and 3.5 hours for breast recon flaps.





Conclusions

Since the intervention of the FLO score chart our institution has seen a dramatic improvement in free flap survival, from 77.5% to 100% in trauma flaps and from 99% to 100% in breast reconstruction flaps.
The FLO chart appears to have improved communication between nurses and doctors, with most cases being promptly reviewed and planned for theatre if appropriate. Nonetheless, the trigger score was not always recorded correctly thus, whether this has had true bearing on the speed at which doctors are informed is uncertain. From responses from 5 nurses in, the chart was an improvement on previous charts and helped assessment of failing flaps and well as communication, yet no formal qualitative data was undertaken.

Further study is recommended to ascertain
- The results over a longer study period
- Whether a high FLO score overall predicts risk of return to theatre or flap failure.
- Qualitative research on the impact of the chart from a nursing and doctor perspective

Additionally, to aid with recording and assessment the authors believe that the FLO chart should be converted into a e-FLO so that electronic results are available, which themselves could act as immediate trigger to clinicians. Plans for an e-FLO are underway

References

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2. Quang Luu, D Farwell. (2009) Advances in free flap monitoring: have we gone too far? Current Opinion in Otolaryngology & Head and Neck Surgery. 17(4):267–269,
3. Chao A. H., Meyerson J., Povoski S. P., Kocak E. (2013). A review of devices used in the monitoring of microvascular free tissue transfers. Expert Review of Medical Devices, 10, 649-660.