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PURPOSE: Individuals with End-Stage Renal Disease (ESRD) and fingertip wounds are at high risk for poor wound healing, ultimately requiring amputations. Current paradigms reserve amputation as a last resort for those who fail medical and nonoperative measures. However, minimal guidelines exist in best management of ESRD patients. Optimal performance of upper extremity amputation (UEA) in ESRD patients is important to decrease complications and minimize the number of operative procedures needed. This study evaluated outcomes of UEA in patients with ESRD and described risk factors predisposing patients to complications.

METHODS: A 5-year retrospective analysis was conducted of 132 patients receiving UEA for non-traumatic fingertip wounds between February 2017 and February 2021. Acutely infected or purulent wounds were excluded. Of these, 26 patients had ESRD, and 106 were nonrenal disease controls. Patient characteristics and clinical endpoints were analyzed between groups. Postoperative complications collected included wound dehiscence, infection, need for additional amputation, and all-cause mortality. Sub-analysis of ESRD patients was conducted to characterize operative course and predictors of complications.

RESULTS: ESRD patients were older than controls (63.6 ± 13 vs 51 ± 16), and had higher rates of comorbid vascular disease (81% vs 21%) and diabetes (92% vs 18%). There was no difference in prior smoking history between ESRD patients (53%) and controls (51%), or other comorbidities collected. Arterial calcification was radiographically apparent in 73% of ESRD patients vs 5.2% of controls. Subgroup analysis demonstrated patients with age greater than 65 did not have significantly higher complication rates (48% vs 42%, p = 0.5). Compared to controls, ESRD patients required more amputations (1.81 vs 1.34, p < 0.001) and total operations (5.19 vs 3.04, p < 0.001) to achieve wound healing. ESRD patients experienced higher rates of postoperative complications (85% vs 31%, p < 0.001). ESRD patients had higher rates of amputation at, or proximal to, the MCPJ (66% vs 9.4%) to achieve a healed wound. Within ESRD patients, average time from first mention of a wound to operative intervention was 77 days ± 70 days. Predictors for complications among ESRD patients were comorbid diabetes (OR 45 [1.7-207.5]), vascular disease (OR 18 [1.56-207.5]), and having a hemodialysis shunt in the affected arm (OR 18 [1.56-207.5]). Within ESRD patients, initial amputation at, or proximal to, the MCPJ led to fewer amputations (1.2 vs 2.19, p = 0.04) and fewer total operative procedures (4.1 vs 6.6, p = 0.03), compared to those who underwent an initial amputation distal to the MCPJ.

CONCLUSION: ESRD UEA patients had higher complication rates, requiring a greater number of, and more proximal amputations, as compared to controls. Conservative treatment gives time for progression of ischemia. The healing ability for patients in the ESRD population with fingertip wounds is significantly different from patients with normal vascular supply. ESRD patients with comorbid vascular disease, diabetes, or a long smoking history should receive prompt surgical consult and vascular exams. If poor perfusion, arterial calcification, or vascular steal are demonstrated, early operative intervention in the form of a single well-planned amputation may allow for more expedient wound healing.

TRACK: MIGRAINE – PERIPHERAL NERVE

In Vivo Functional Outcomes of Stem Cell Delivery Methods to Acellular Nerve Allografts

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BACKGROUND: Different cell delivery methods have been described to supplement biological scaffolds, such as acellular nerve allografts (ANAs). We sought to investigate the functional motor recovery of ANAs after dynamic seeding versus microinjection of adipose-derived mesenchymal stem cells (MSCs).

METHODS: Forty Lewis rats underwent reconstruction of a 10-mm sciatic nerve defect. Animals were divided into four experimental groups (n = 10/group): I) autograft, II) ANA, III) ANA dynamically seeded with MSCs, and IV) ANA injected with MSCs. In group III, ANAs were dynamically seeded with 1x10^6 MSCs on a bioreactor for 12-24 hours prior to surgery. ANAs in group IV were longitudinally injected with 1x10^6 MSCs in 10 μL of culture medium over the entire course of the nerve graft. During the survival period, the tibialis anterior (TA) muscle...
cross-sectional area was measured using ultrasound imaging. In non-survival procedures at 12 weeks, measurements of ankle contracture, compound muscle action potential (CMAP), isometric tetanic force (ITF), and wet muscle weight (MW) were determined. All results were expressed as a percentage of the contralateral non-operated side.

RESULTS: TA cross-sectional area recovery was significantly higher in groups III and IV compared to groups I and II at week 8. Group IV also showed significantly higher recovery rates than group I and II at week 4. The ankle contracture and CMAP amplitude were inferior in ANAs alone compared to all other groups. Group IV demonstrated significantly higher ITF and MW compared to ANAs alone. No significant differences were observed between ANAs dynamically seeded with MSCs and ANAs injected with MSCs.

CONCLUSION: Addition of MSCs to ANAs demonstrated earlier regeneration compared to ANAs alone and autografts and were demonstrated as early as postoperative week 4. Both methods of seeding improved functional outcomes. The method chosen for human translation must be technically feasible, reproducible, and timely.

TRACK: RESEARCH/TECHNOLOGY

Ex Vivo Subnormothermic Preservation of Porcine Superior Epigastric Artery Perforator Flaps

Presenter: Ryan Khalaf

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PURPOSE: Reconstruction of complex head and neck, breast, and extremity defects often require autologous transfer of vascularized tissues and restoration of perfusion microsurgical repair of the vascular pedicle. Flap failure, caused by vascular thrombosis (~5.1%), leads to significant patient morbidity, longer hospitalizations, and greater health care costs. In vessel-depleted or sick patients, free flap reconstruction is challenging. The aim of this study was to develop a protocol for Ex Vivo Subnormothermic Preservation (EVSNP) of flaps. We hypothesized that EVSNP can maintain flaps in near physiologic conditions for at least 12 hours.

METHODS: Twelve superior epigastric artery perforator flaps were procured from Yorkshire pigs. Flaps were preserved using ex vivo subnormothermic perfusion (EVSNP, n=6) with an oxygenated colloid solution containing HBOC-21 as oxygen carrier or at 4°C (static cold storage control) for 12h (n=6). Outcome measures, including perfusate dynamics, temperature, gases, metabolites, electrolytes, and flap weight, were monitored and evaluated using Pearson correlations and paired t-tests. Skin biopsies were taken every 6 hours for Hematoxylin and Eosin (H&E) histological evaluation (perivascular inflammation, spongiosis, vacuolization of epidermal cells and epidermal necrosis). Indocyanine Green (ICG) angiography was utilized to analyze skin perfusion before division of the flap pedicle and after 12 hours of EVNP.

RESULTS: Mean perfusate flow was 10±0 ml/min at baseline and increased to 16±2 ml/min at TP12 (p=0.002). Mean arterial pressure (45±13 mmHg) remained stable during EVNP (r=0.08, p=0.78). Mean perfusate and flap temperatures were 30.9±1.4°C and 28.4±1.6°C, respectively. Mean arterial PaO2 was 490±74 mmHg and decreased from 566±41 at baseline to 448±56 at perfusion end (p=0.004). PaCO2 was 21±1 mmHg on average, not changing significantly from baseline (TP0.5 21±1 vs. TP12 21±1, p=0.19). PvCO2 was 24±3 at baseline and decreased to 19±1 at TP12 (p=0.04). The average pH was 7.37±0.02 and was comparable to baseline at TP12 (TP0.5 7.36±0.02 vs. TP12 7.37±0.02, p=0.14). Mean arterial glucose was 4.7±0.7 mmol/L. Venous lactate was 5.1±0.8 mmol/L and remained comparable at perfusion end (TP0.5 4.8±0.5 mmol/L vs. TP12 5.4±1.3 mmol/L, p=0.18). Creatine kinase increased over time (TP0.5 864±468 U/L vs. TP12 6340±1764 U/L, p=0.001; r=0.99, p=0.01). Venous methemoglobin was 32.3±10.0%, and increased during perfusion (r=0.96, p<0.0001). Potassium remained in a physiologic range (mean 3.9±0.22 mEq/L), increasing from 3.7±0.2 mEq/L at baseline to 4.1±0.2 at TP12 (p=0.0005). Sodium was slightly elevated (mean 159±3 mEq/L) and increased from baseline 157±0.4 mEq/L to 162±2 mEq/L (p=0.0004). Flap weight did not change from beginning to end of perfusion (TP0 0.222±0.041 kg vs. TP12 0.223±0.044 kg, p=0.48) or in controls (TP0 0.136±0.067 kg vs. TP12 0.135±0.067 g, p=0.48). There was no difference between the percent change...