The Art of Poster Making

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• REU Workshop

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Used materials from:
George Hess :: Kathryn Tosney :: Leon Liegel
http://www.ncsu.edu/project/posters
An effective poster is a visual communications tool. ...

get your main point(s) across to as many people as possible.

An effective poster operates on multiple levels ...

- source of information
- conversation starter
- advertisement of your work
- summary of your work
| **Planning** | Before starting work on your poster, consider message, space, budget, format (single sheet or multi-panel), and deadlines. |
| **Focus** | Stay focused on your message and keep it simple. Create a mock-up and dispense with unneeded details. |
| **Layout** | Use a clearly defined visual grammar to move readers through your poster. |
| **Headings** | Use headings to orient readers and convey major points. |
| **Graphics** | Clear graphics should dominate your poster. |
| **Text** | Text should be minimized in favor of graphics, and large where used. |
| **Colors** | Colors can make a poster attractive and improve readability, but be cautious. |
| **Editing** | Edit ruthlessly to reduce the amount of text and focus on a results-oriented message. |
| **Software** | There are many packages you can use to create your poster. |
Planning: Message

Know your message!

What is the *one* thing you want your audience to learn?

**Focus** on your message throughout the poster.

If it doesn't reinforce your message, *leave it out!!*
Planning: Message

If you have an interesting result, state it explicitly in the title.

The Effect of X on Y vs.
Substance X Induces Y-cells

Make the strongest statements your data will support. Why soft-peddle exciting findings?

Rather than merely repeating the results, state your interpretations in the conclusion section.
substance X induces Y-cells

Context
Y-cells require induction, X-substance may be the inducer because:

1. We created X-deficient mice
2. X is expressed in Y-cells only
3. Anti-X inhibits Y cell origin
4. Anti-X alters Y transcription
5. Y-cells need Y-transcription

Summary
X:
- Is expressed in Y cells
- Induces Y expression
- Induces Y transcription factor

Conclusions
X induces Y-cells by inducing the Y transcription factor

We acknowledge NIH grant # XXX.
Message: Audience

There are three categories of readers in most audiences (Woolsey 1989). People in ...

• your field of specialization
• fields closely related to yours
• unrelated fields

To satisfy them all, you should ...

• Explain the big picture and why the problem is important.
• Use plain language, avoid jargon and acronyms
• Interpret your findings: how your work helps solve the problem you've described.
Message: Focus & Keep It Simple

Simple messages are more memorable.

Details distract from the main point, and can be supplied in person as needed.
What’s wrong with this poster?
Focus: consider the alternatives

Do this ... Edit ruthlessly! Simplify. Supply details in person, and only as needed.

Remove all but the most essential information about your methods.

State your results with headings, and focus on results and conclusions.

Convince viewers (potential employers) that you are a thoughtful, results-oriented researcher.
Focus: consider the alternatives

... not this. Emphasize methods rather than the main message. Identify every detail of your methods, just in case you're not in front of your poster when someone comes by.

Even in the results and conclusions, be sure to emphasize your methods over your findings.

Convince viewers (potential employers) that you are a task- and methods-oriented technician.
Your poster should have a good visual balance of figures and text, separated by white space. Balance occurs when images and text are reflected (at least approximately) across a central horizontal, vertical, or diagonal axis. This axis is know as the axis of symmetry.
Layout: Balance and White Space
Do this ... Use a graphic hierarchy that visually reflects the relative importance of elements.

If it's important, make it BIG. Use type size proportional to importance.

Show, don't tell. No need to write down every detail.

Use simple figures and graphs, which should dominate the poster visually.

Make all graphic elements large enough to be visible easily from one meter away.

... not this Use a text-heavy, publication-style format.

Use 12-point font for just about everything. Actually, you could just staple up your manuscript - why not?

Include every detail as you would for a journal article

Use complex, difficult to understand graphics, which are only a small portion of the poster.

Make sure your figures are all small enough to fit on a small portion of a journal page.
Text: should be simple, direct, and large.

- Posters are a **visual medium**.
- Minimize text - use images and graphs instead.
- Keep text elements to 50 words or fewer.
- Use phrases rather than full sentences.
- Use an active voice.
- Avoid jargon (depends somewhat on **audience**).
- Left-justify text; avoid centering and right-justifying text.
- Sans-serif font (e.g., Helvetica, Arial) for most text - easier to read
- Text should be at least 24 point in text, 36 for headings.
- Pay attention to text size in figures - it must also be large.
- Title should be at least 5cm tall.
Do this ... Make text simple, direct, and large enough to read so that your message comes through loud and clear!

Title and major headings should be readable from 2m away.

Supporting material should be visible from 1m away.

Details should be kept to a minimum, and still visible from 1m away.

Avoid long lines of text.

... not this Make text convoluted, impenetrable, and small enough that viewers will go away.

Headings are to be small, so you can fit everything in.

Only text that lacks intrinsic content - like "Results" - should be readable from 1m away.

Make text tiny, as in a published paper, so you can squeeze in all the detail.

Make lines of text so long that the readers lose their place when trying to find the next line.
Color

Use color to attract attention, organize, and emphasize - but don't overdo it.

• Use a light color background and dark color letters for contrast.

• Avoid dark backgrounds with light letters - very tiring to read.

• Stick to a theme of 2 or 3 colors - much more will overload and confuse viewers.

• If you use multiple colors, use them in a consistent pattern - otherwise viewers will spend their time wondering what the pattern is rather than reading your poster.

• Overly bright colors will attract attention - and then wear out readers' eyes.

• Consider people who have problems differentiating colors, especially when designing graphics - one of the most common is an inability to tell green from red.
Use color to attract attention, organize, and emphasize - but don't overdo it.

Do not convey information with color only. Show differences BOTH in color and in shape.

“redundant coding”

In addition to color, use the combinations of:
- solid and various dotted lines
- various hatching
- circles, triangles, and rectangles
- alphabets and numbers
- etc.

Keep the number of colors to a minimum.

Use combinations of different symbols with a few, vivid colors rather than a single symbol with various colors.

Keep contrast not only in hue but also in brightness.

Make it possible to communicate without using color name.
Mock strawberries as they appear to a person with full-color vision.

Mock strawberries as they appear to a person who cannot tell red from green.

**Bad!**

**Annual GFP increase**
- Germany
- U.S.A.
- U.K.
- Japan

**Good!**

**Annual GFP increase**
- U.K.
- Japan
- U.S.A.
- Germany
Editing

If it doesn't provide critical support for your main message, ELIMINATE IT!

Edit! Edit! Edit ruthlessly! to reduce text. Edit all text to simplify verbiage, to reduce sentence complexity, and to delete details.
Presentation

... Do not do this

Give a detailed tour and be compulsively complete.
Read carefully every line.
Read all the text, trace every line on every graph, and dwell especially on the details of the methods.
If you stand with your back to your audience, many people will find it easier to escape. Glance over your shoulder periodically to see if you can stop reading yet.

Speak in a low tone - and don't help viewers see what you're trying to show them
Presentation

Do this ... Use the graphics when you talk and focus on your evidence.

Use your poster as a visual aid.

When people ask you for a tour of your poster, use the graphic elements to explain your work.

Face your audience and tell them the context: identify the big problem, explain why the problem is important, and tell what you did to answer it, what the answer is, and what the answer means.

As you talk in an audible, measured pace, point to the graphic features that demonstrate your message. Glancing at the figure as you point to it will direct your viewers' eyes to the figure.
FEEDBACK from GRADUATE STUDENTS:

- Know size/format/printer requirements
- Large Font; Deep colors
- No paragraphs – use bullet lists
- Less text, more pictures, photos, etc
- Use the section titles/subtitles to guide you in the presentation – should be easy to see/say
- Spellcheck and proofread!!!
- Placement of the most important information in the center
- Know appropriate ways to make figure/plot bigger – issue of pixellation

PRESENTATION TIPS:

- Be excited!!!
- Presentation should be not more than 5 min; about 20 sentences.
- Allow people to look at the poster for a few minutes before “attacking” them
- Do not present the sequence of How you did it; Choose information wisely and present only the most important results, leave the rest for questions.
- Rehearse the presentation with correct pauses and intonations.
INTRODUCTION

Capillary assembly by vascular endothelial cells (angiogenesis) occurs as part of physiological responses to injury during wound healing, as well as pathological processes, such as tumor growth. Angiogenic processes can be influenced by a variety of factors, including mechanical and chemical properties of the extracellular space, as well as signals from the external environment. High frequency electromagnetic fields (EMFs), such as those used in civilian and military communication systems and computers, have been shown to elicit a variety of biological and cellular responses. However, the effects of these fields on the process of angiogenesis are not understood, and the existing literature is controversial, suggesting that angiogenic response is sensitive to the experimental conditions, such as thermal overheating, field amplitude, signal frequency and modulation. Thus, studies suggested that 4 Pulsed electromagnetic fields at 15 Hz accelerate angiogenesis in vitro [1] and wound healing by diabetic and normal conditions via up-regulation of angiogenic factor PGE-2 [2]. Altered gene expression, possibly associated with up-regulated cell metabolism, has been reported for endothelial cells exposed to high frequency EMF at 1000 MHz to 1.6 GHz [3]. On the other hand, no effects of 1.4 GHz EMF exposure on brain microcirculation was found [4]. At present, the mechanisms of EMF action on vascular cells and capillary assembly are not understood. Therefore, the objectives of this study was to quantify microvascular endothelial cell to EMF when embedded in short self-assembling peptides.

We have previously demonstrated and quantified that self-assembling peptide based microenvironment regulate angiogenesis, hence promoting long-term cell survival and capillary-like network formation in three-dimensional cultures of microvascular endothelial cells [5].

HYPOTHESIS

We hypothesized that low-frequency EMF (7-25Hz) will promote in vitro angiogenesis and proliferation of mouse microvascular endothelial cells seeded in the three-dimensional peptide nanoscaffold.

METHODS

Exposure to EMF

We have designed and built the custom experimental setup, allowing selective application of low frequency microwaves of a known type (electrical and/or magnetic) (Figure 1). One of the cell-seeded inserts was placed in a microwave resonator, located inside a temperature-controlled 5% CO2 incubator. The microwave excitation (at 7.0-7.5GHz) was delivered from the Vector Network Analyzer to the resonator via a critically-coupled coax line and a reflected signal sweep used to measure the power loss in the resonator [6]. For non-stimulated control, the second insert with seeded endothelial cells was placed in the same incubator, but outside the resonator chamber.

RESULTS

Peptide nanoscaffold preparation and cell seeding

Microvascular endothelial cells were isolated from mouse heart and lung tissue using collagenase digestion and double sorting with CD141- and CD102-coated magnetic beads (Dynabeads) [7]. For each experiment, 5D peptide nanoscaffold (RAD6-H-1.0% w/w) was pre-formed in two 12-mm diameter culture inserts (Millepore). Endothelial cells (6 x 10^4 cells/ml) were seeded on the nanoscaffold and allowed to attach for 1 hr in Medium 199 (Atlanta Biologicals), 10% FCS, 1% PBS + 10 µg/ml heparin. To assess cell proliferation, medium was supplemented with 25 µM bradykinin (ReDu, BD Bioscience).

RESULTS

At 12 hours after seeding, capillary-like networks formed in both EMF-stimulated (Figure 2) and control samples (not shown).

Figure 2: Capillary network formation by seeded endothelial cells on peptide scaffold following 12 hr exposure to EMF.

Summary

Our results demonstrate that the endothelial cell exposure to EMF promotes angiogenesis in vitro. Cell proliferation analysis using ReDu suggest that the EMF-induced angiogenic stimulation likely occurs through mechanism which does not involve proliferation. Studies are ongoing to determine the effects of EMF exposure on cell viability, and whether enhanced capillary assembly is associated with increased formation of intercellular gap junctions, which represent the important pathway for cell-cell communications. These results contribute to better understanding of the role of the external environment on the mechanisms for neovascularization, and how this process can be manipulated for different vascular tissue engineering applications.

REFERENCES


ACKNOWLEDGEMENT

This project was supported by AHA BOR-0756452M (DAN) and start funds from UC-BME (DAN) and Physics Department (ABK).
MICROWAVE FIELD ENHANCES CAPILLARY-LIKE NETWORK ASSEMBLY BY MICROVASCULAR ENDOTHELIAL CELLS

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1 Biomedical Engineering Department, University of Cincinnati, Cincinnati, Ohio; 2 Physics Department, University of Cincinnati, Cincinnati, Ohio;

INTRODUCTION
Capillary assembly by vascular endothelial cells (angiogenesis) occurs as part of physiological responses to injury during wound healing, as well as pathological processes, such as tumor growth. Angiogenic process can be influenced by a variety of factors, including mechanical and chemical properties of the extracellular space, as well as signals from the external environment. High frequency electromagnetic fields (EMFs), such as those used in civilian and military communication systems and computers, have been shown to elicit a variety of biological and cellular responses. However, the effects of these fields on the process of angiogenesis, while important for military and medical applications, are not understood. The existing literature is controversial, suggesting that angiogenic response is sensitive to the experimental conditions, such as thermal overheating, field amplitude, signal frequency and modulation. Previous studies suggested 4.5msec pulsed electromagnetic fields at 15 Hz accelerate angiogenesis in vitro [1] and wound healing under diabetic and normal conditions via up-regulation of angiogenic factor FGF-2 [2]. Altere gene expression, possibly associated with upregulated cell metabolism, has been reported for endothelial cells exposed to high frequency EMF at 900MHz to 1.8GHz [3]. On the other hand, no effects of 1.439 GHz EMF exposure on brain microcirculation was found [4]. At present, the mechanisms of EMF action on vascular cells and capillary assembly are not understood.

Methods

Peptide scaffold preparation and cell seeding
For each experiment, 3-D peptide nanoscaffolds (RAD19-1) [2], 1.0% w/w were pre-formed in two 12-mm diameter culture inserts (Millipore). Endothelial cells (8x10^5 cells/cm²) were seeded on the nanoscaffold and allowed to attach for 1 hr in culture medium (M199-Atlanta Biologica, 10% FCS, 1% ps + 10 µg/ml heparin.) To assess cell proliferation, medium was supplemented with 30 U/ml bromodeoxyuridine (BrdU, BD Bioscience).

RESULTS

At 12 hours after seeding, capillary-like networks formed in both EMF-stimulated (Figure 2) and control samples (not shown).

Correlation analysis of network formation
5 gray scale images of cell distribution (DAPI) in EMF stimulated and control cell seeded peptide scaffolds were taken at random locations using fluorescent microscope (Olympus-IX81). The correlation function F(x,y) was calculated for each image using the equation:

\[ F(x,y) = \frac{(\text{I}(x,y) \text{I}_\text{ave})(\text{I}(x+a,y+b) \text{I}_\text{ave})}{\sigma^2} \]

where (x,y) represent pixel coordinates on the original image, (x+a, y+b) represent correlation distances in pixels along the x and y directions, I(x,y) is intensity image at x,y, < > denotes averaging over I(x,y), I_ave is average intensity and o^2 is the standard deviation. F(x,y) is the probability of finding a cell located around (x+a,y+b) given that a cell is located at position (x,y).

Correlation analysis of cell structures (n=3 in each group) demonstrated that high frequency EMF stimulation resulted in significantly larger size of structures, as compared with non-stimulated controls (Figure 3, p<0.01, ANOVA), reflecting an increase in network characteristic size from a single-cell nucleus to multicellular networks (Fig.3e). In contrast, non-stimulated cell seeded peptide scaffold exhibited less noticeable spatial re-arrangement.

Cell proliferation
BrdU assay did not show significant difference between proliferation index in EMF stimulated samples (3.0 +/-1.4 BrdU-positive cells per high power field, 20x) vs. controls (2.9 +/- 0.7 BrdU-positive cells per high power field, n=2).

SUMMARY
Our results demonstrate that the endothelial cell exposure to high frequency EMF promotes angiogenesis in vitro. The results of cell proliferation analysis suggest that the EMF-induced angiogenic stimulation likely occurs through mechanism which does not involve proliferation. Studies are ongoing to determine the effects of EMF exposure on cell viability, and whether enhanced capillary assembly is associated with increased formation of intercellular gap junctions, which may represent an important mechanism for cell-cell communications during capillary assembly. These results contribute to better understanding of the role of the external environment on the mechanisms for neovascularization, and how this process can be manipulated for different vascular tissue engineering applications.

REFERENCES

ACKNOWLEDGEMENTS
This project was supported by AHA BQR-07564258 (DAN) and startup funds from UC-BME (DAN) and Physics Department (ABK).

HYPOTHESIS: We hypothesized that high frequency electromagnetic fields (GHz) will promote in vitro angiogenesis and proliferation of mouse microvascular endothelial cells seeded in the 3D peptide nanoscaffold.

Microvascular endothelial cells were isolated from mouse heart and lung tissue using collagenase digestion and double sorting with CD31- and CD102-coated magnetic beads (Dynabeads) [7]. Cells up to passage 12 were used in the experiments.
Southern Flounder Exhibit Temperature-Dependent Sex Determination
J. Adam Luckenbach*, John Godwin and Russell Borski
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Introduction
Southern flounder (Paralichthys lethostigma) support valuable fisheries and show great promise for aquaculture. Female flounder are known to grow faster and reach larger adult sizes than males. Therefore, information on sex determination that might increase the ratio of female flounder is important for aquaculture.

Objective
This study was conducted to determine whether southern flounder exhibit temperature-dependent sex determination (TSD), and if growth is affected by rearing temperature.

Methods
- Southern flounder broodstock were strip spawned to collect eggs and sperm for in vitro fertilization.
- Hatched larvae were weaned from a natural diet (rotifers: Arctina) to high protein pelleted feed and fed until satiation at least twice daily.
- Upon reaching a mean total length of 40 mm, the juvenile flounder were stocked at equal densities into one of three temperatures 18, 23, or 28°C for 245 days.
- Gonads were preserved and later sectioned at 2-6 microns.
- Sex-distinguishing markers were used to distinguish males (spermatogenesis) from females (oogenesis).

Histological Analysis
Male Differentiation  Female Differentiation

Temperature Affects Sex Determination

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<thead>
<tr>
<th>Temperature (°C)</th>
<th>% Females</th>
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<td>18</td>
<td>20</td>
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<tr>
<td>23</td>
<td>40</td>
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<tr>
<td>28</td>
<td>60</td>
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Growth Does Not Differ by Sex

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<tr>
<th>Temperature (°C)</th>
<th>Body Weight (g)</th>
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<td>37</td>
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<td>23</td>
<td>51</td>
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Results
- Sex was discernible in most fish greater than 120 mm long.
- High (28°C) temperature produced 4% females.
- Low (18°C) temperature produced 22% females.
- Mid-range (23°C) temperature produced 44% females.
- Fish raised at high or low temperatures showed reduced growth compared to those at the mid-range temperature.
- Up to 245 days, no differences in growth existed between sexes.

Rearing Temperature Affects Growth

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<th>Temperature (°C)</th>
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Conclusions
- These findings indicate that sex determination in southern flounder is temperature-sensitive and temperature has a profound effect on growth.
- A mid-range rearing temperature (23°C) appears to maximize the number of females and promote better growth in young southern flounder.
- Although adult females are known to grow larger than males, no difference in growth between sexes occurred in age-0 (< 1 year) southern flounder.

Acknowledgements
The authors acknowledge the Substantial Fisheries Service and the University of North Carolina Sea Grant College Program for funding this research. Special thanks to Les Ware and Beth Shimp for help with the work.
Positive Points

The title conveys the main message instantly. Context and objectives are made clear. Methods are concise. Graphs are interpreted by their titles. One can read the titles and trust the authors, or examine the graphs in more detail. Results and conclusions are concise and relate back to objectives. Color scheme is very simple and pleasing. Font is large enough everywhere, including figures.

Negative Points

Results and conclusions do not relate back to context (Introduction). It would be nice to see a statement of how the findings relate to aquaculture. Some viewers have noted that the title could be more direct: "Temperature Determines Sex of Southern Flounder". Title font is on the small side - could be larger. Some viewers have felt there is too much white space between the columns. It could be reduced somewhat, but not too much.